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Is the Day of the Armored Battleship Ending?

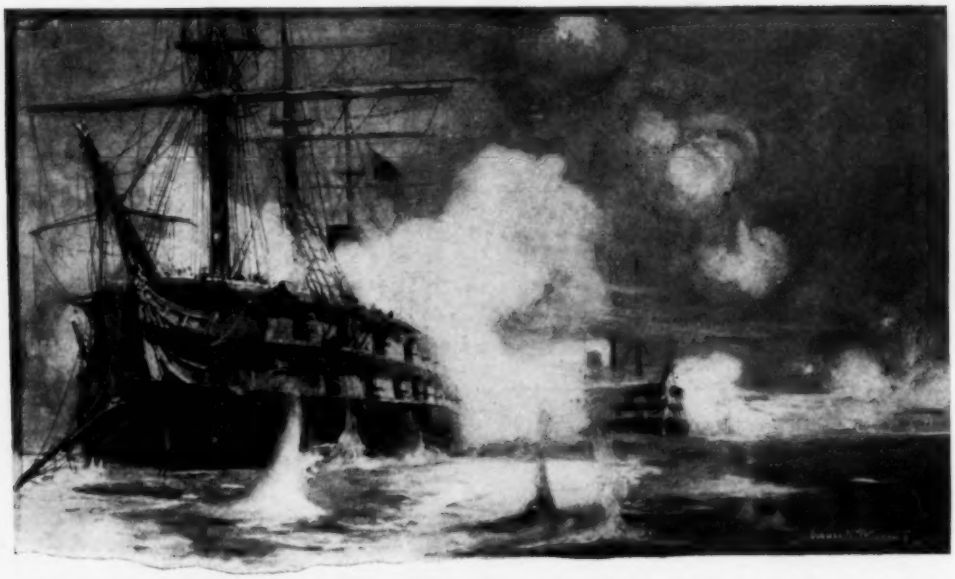
The Evolution of the Fighting Vessel Shows That All Great Conflicts Have Produced Radical Changes in Style of Construction

The Old and the New

Has the great modern steel armored battleship become a thing of uselessness? Is this Goliath of the main helpless in combat with the little torpedo craft, which, David-like, can hurl the missiles that wreak destruction on its giant adversary? Has the United States made a bad investment in spending $150,000,000 on battleships?

Often in the past it has been that a new type of fighting machine has completely revolutionized warfare. A newly invented death-dealing device has frequently decided the fate of war. An inventor many times has conquered armies where forces of men and ships have failed. So it has been since the beginning of wars that the side which could devise the most effective weapons of destruction has won the greatest victories, for it is war's mission to destroy. The evolution of the ironclad battleship is one demonstration of this truth. The evolution of fire arms tells the same story. First one means of combat and then another has passed into oblivion, from the times of the sling shot, the cross-bow and the javelin on land, each giving way to more formidable weapons, until now we have the mauser rifle and the gatling gun. On the sea, the galley, the sailing vessel and the wooden battleship have each in turn given way to stronger, more destructive craft, until now we have the great steel armored vessels. And in the Japanese-Russian war these great steel armored vessels have been blown to atoms by the little torpedoes and submarine mines. Hence the question has arisen, is an era of new marine fighting methods upon us? Is the heavy steel armored vessel longer useful?

Senator Hale of the United States in a



Proof of Necessity for Ironclads: Wooden Ships "Agamemnon" and "Sans-pareil," under Shell-Fire of the Sebastopol Forts, 1854

recent congressional session contended that the battleship is at the mercy of the torpedo and is a valueless, dangerous investment. So effective was his contention, that the United States government has probably decided to devote more of its means and energies to the building of first-class cruisers and torpedo boats instead of battleships. The naval appropriation bill, over which the argument arose, gives the President and Secretary of the Navy discretion to defer the construction of the battleship authorized by it. It is contended that the modern war vessel with its steel armament and great guns is so heavy that with slight injury it turns turtle and sinks as did the "Petropavlovsk" and the "Victoria."

H. M. S. "Achilles," the First British Warship with Complete Armor Belt

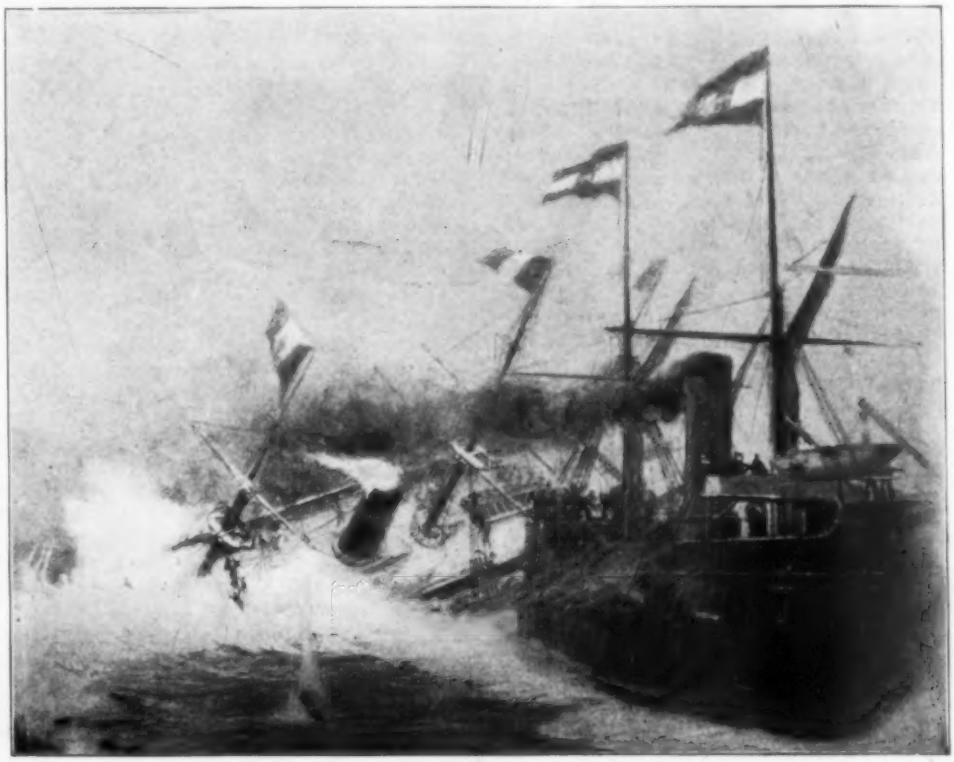
A recently printed comment on marine warfare states: "The remarkable success of the Japanese at Port Arthur—the crippling of the 'Retvizan' and the 'Czarevitch' with torpedoes, and the sinking of the 'Petropavlovsk' and the disabling of the 'Pobieda' by contact mines—has filled many with sudden contempt for battleships. They say that a revolution has been worked in naval warfare and that the fighting nations of the earth will be obliged to discard the vulnerable engines of war, into which they have put so much money, and build more torpedo boats, especially submarine ones, and torpedo boat destroyers."

Every great war brings forth radical changes in fighting machines that affect the whole world; makes many time-honored

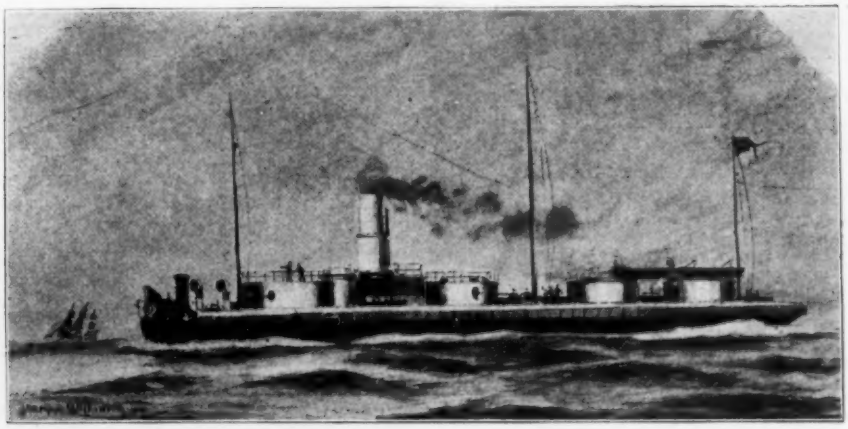
devices useless and ushers into general usage new and more formidable contrivances. As the Civil War in the United States brought forth the submarine mine and the torpedo, so it introduced the armored ship in battle and the turret vessel, both of which revolutionized the navies of the world and are responsible for our present types of fighting vessels.

Shells were used for the first time by ships against ships on Nov. 30, 1853, when the Russians attacked and destroyed a squadron of Turkish frigates at Sinope on the north coast of Asia Minor. The Russian guns were provided with shells and the result of their fire was disastrous to the Turkish squadron. Every one of the Turkish ships, except a small steamer which escaped, was in flames in a few minutes, and burned. English vessels suffered severely from shell-fire at the bombardment of Sebastopol on October 17 of the following year. This great siege marked a new era in the building and equipment of war vessels, which hitherto had been practically the same for two centuries. It became evident that unless some means of protection could

First Use of Ironclads: the French Floating Batteries Bombarding Kinburn with Impunity, October 17, 1855



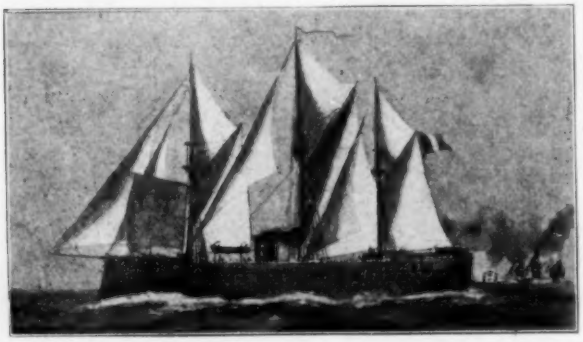
In the Days of the Ram--The Austrian Flagship "Ferdinand Max," Ramming and Sinking the Italian Armored Frigate "Re D'Italia" at the Battle of Lissa, July 20, 1866



First Turret-Ship: The "Royal Sovereign," as Remodeled in Consequence of the "Monitor"-"Merrimac" Duel, 1862

be devised, ships could no longer hope to attack shore batteries provided with shell guns, with any chance of success.

During 1855 a certain number of what were called floating batteries were built in France and England. They carried a heavy armament—sixteen 68-pounders—and they were protected by four inches of iron on 20 inches of wood, with a bullet-proof iron shelter for the helmsman, from which has sprung the modern conning tower. Three of these French floating batteries aided the English in the attack on Kinburn, Oct. 17, 1855. Anchored some 800 yards from the main fort, their heavy guns poured a crushing fire upon the Russian works, while the shot and shell from the Russians produced absolutely no effect upon them. "Everything may be expected from these formidable engines of war," wrote Vice-Admiral Bruat, the French commander-in-chief, in his report to the emperor.

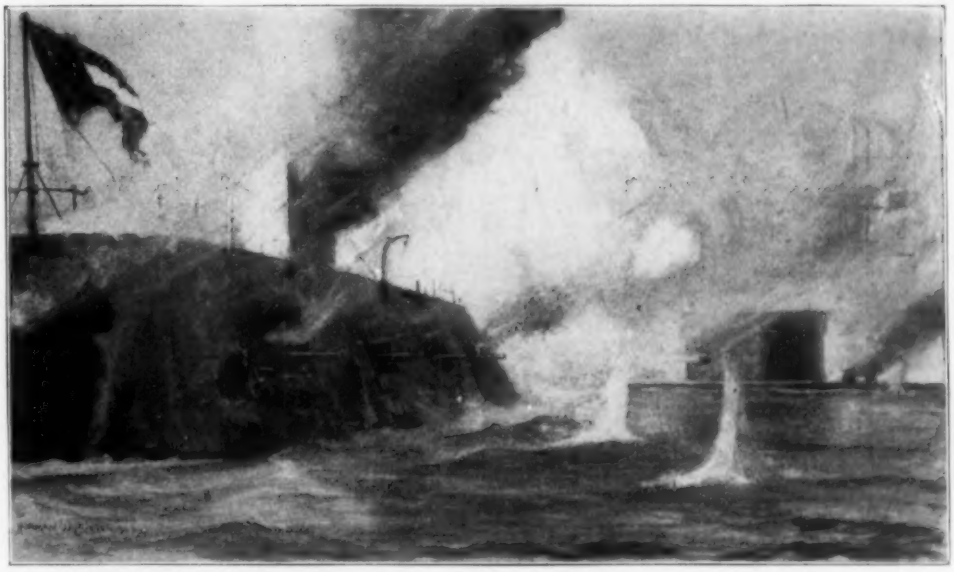


First Sea-Going Ironclad: French Vessel, "Gloire," Launched 1860

After that the French built the "Gloire," the first sea-going ironclad, and the "Black Prince," and others followed in close succession, but it remained for the United States later to demonstrate the formidability of the ironclad in actual battle. The armor of all these European vessels was much the same and consisted of a 6-inch belt at the waterline tapering to four inches on other parts of the hull. The principal armament was still carried on the main deck as in the old wooden frigates. One important change was to be noted, however. The old smooth-bore gun had given way to the rifled, and the weight and size of the new guns had already materially increased. Instead of the 68-pounder the ships were armed with a 7-inch 6½-ton gun, which threw a projectile of 115 pounds.

How formidable a weapon the ram may be in warfare is shown by the sinking of the Italian armored frigate "Re d'Italia," at the Battle of Lissa, July 20, 1866, by the Austrian flagship, the "Ferdinand Max;" the sinking of the "Vanguard" by the "Iron Duke" in the Irish channel, Sept. 1, 1875, and the "Victoria" by the "Camperdown" in 1893, which latter ship sunk within 10 minutes after having been struck.

The introduction of rifled guns marked a turning point in the history of the navy and was distinctly due to the introduction of armor, as it soon became evident that the heaviest spherical projectile from a smooth-bore gun was quite inadequate to pierce the newly adopted armor-plates. Experiments soon



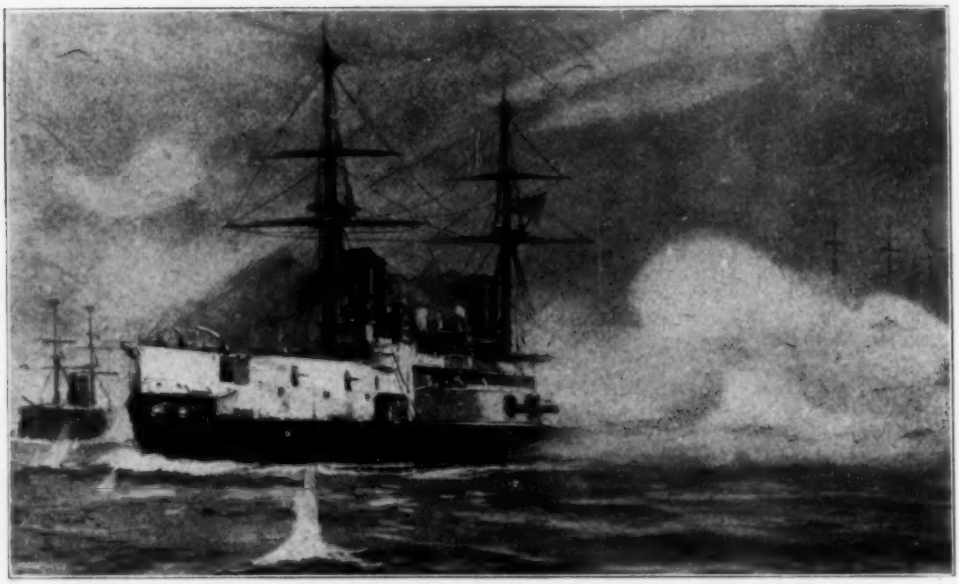
Battle of the "Merrimac" and the "Monitor," March 9, 1862

showed that only to projectiles of an elongated form, combining as much weight as possible with small diameter, could the velocity and penetrating force be given which would cope successfully with the new defensive powers afforded to ships by armor-plating. Elongated projectiles, however, have a tendency to turn end over end, as the pressure of the air acts unequally upon them when they have left the bore of the gun; and to counteract this tendency and to keep the projectile point foremost, it was necessary to make it spin or rotate about its longer axis, and this could only be done by means of rifling. Rifled guns thus became a necessity and with their definite adoption in 1864 began the great contest between guns and armor, which has lasted ever since and which is now being carried on with as much energy as ever.

The London Illustrated News says: "The Civil War in the United States broke out in 1860 and on March 9, 1862, there was fought in Hampton Roads the first naval action between armored ships, the result of which was destined ere long to revolutionize the whole system of battleship construction."

When Norfolk, with its dockyard, was evacuated by the federal troops, the "Merrimac," a large 60-gun frigate under repair, was set on fire to prevent her falling into the hands of the Confederates; she was only partly burnt, however, and the Confederates found her in all essential respects uninjured. Painfully conscious of their weakness at sea, the Confederate authorities determined to attempt the construction of an armored ship which would be able to cope successfully with the numerous wooden vessels of the Northern fleet. The Merrimac was cut down to the waterline and a rectangular casemate extending from two feet below the waterline to seven feet above was then built over her, the sides of which were sloped at an angle of 35 degrees; they were made of 20 inches of pine, with an outer layer of four inches of oak, on which were secured two layers of armor-plating, manufactured from railway rails. She carried 10 guns, including a 100-pounder Armstrong

Last Broadside Battleship, H. M. S. "Alexandra," Launched 1875



The First "Citadel" Ship and the Last to Carry Muzzle-Loading Rifled Guns and Iron Armor: H. M. S. "Inflexible," at Bombardment of Alexandria

gun mounted at each end of the casemate. The "Merrimac" was spreading desolation in her path when her career was finally and abruptly checked by an antagonist, which though much smaller, proved more than a match for her. This antagonist was the celebrated "Monitor," built and designed by Captain Ericsson. She was 210 feet long and was only two feet out of the water; her deck and her low sides were plated, and she carried two 150-pound Dahlgren guns in a single turret amidships, which was worked by steam and protected by eight 1-inch iron plates screwed together, while besides the turret nothing showed on deck except her funnel and armored pilot-house. She thus offered nothing as a target except her turret which proved impenetrable to the "Merrimac's" guns, while the heavier ones she herself carried inflicted considerable damage to her opponent's casemate, so that the "Merrimac" was eventually forced to withdraw. It was, to a certain extent, a draw battle; but indecisive as it was, it really settled the question of "broadside" versus "turret" in favor of the latter.

The "King Edward VII," the greatest war vessel ever built, is a descendent of the little "Monitor." The London News further says:

"The step between the 'King Edward VII' of today and the insignificant-looking little 'Monitor' of 1862 is a very long one, and the connection between the two ships may not, at first sight, be apparent; but the barbettes on the center line of the modern battleship, in which her heavy guns are mounted, are simply a development of the turret principle, the value of which was so fully proved in Ericsson's experimental vessel on the calm March morning in 1862.

"Great was the excitement caused, especially in England, when the news of the action arrived and a demand immediately arose for conversion of our fleet into turret ships."

In England and everywhere the rebuilding of battleships was made necessary. The "Royal Sovereign" of the British navy was cut down, armor-plated and fitted with four turrets, each carrying four 9-ton guns. The weight was too heavy for the hull and she was not a decided success. She was followed by small double-turreted vessels, built for the English coast defense and in 1870 the two large sea-going turret ships "Monarch" and "Captain" were completed in England. Similar vessels were constructed by all leading navies of the world.

The "Devastation," "Thunderer" and "Dreadnaught," built by England in 1872, were the first ships to be provided with the "military mast," fitted with a fighting top in which are carried small quick-firing guns;

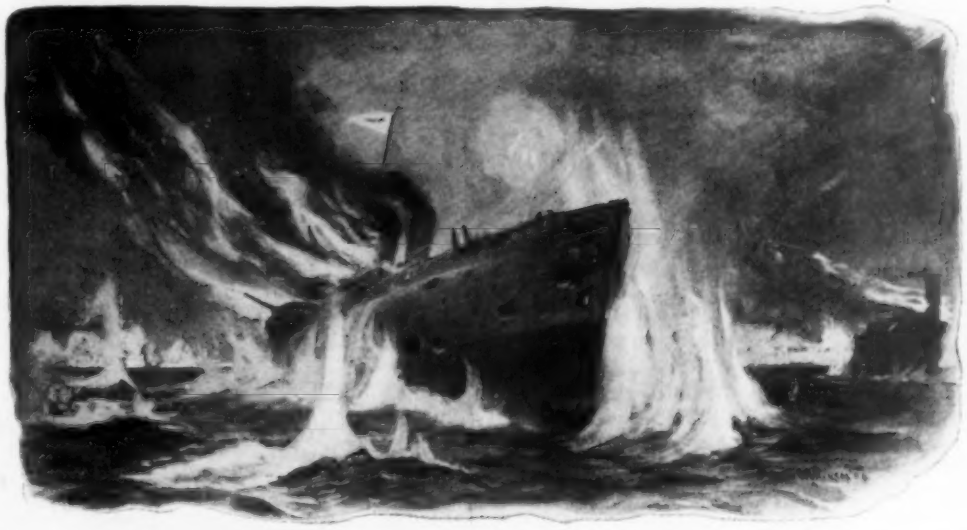
they had two sets of engines driving twin screws, a system which was rapidly superseding the single screw in warships, owing to the extreme handiness in maneuvering. The "Devastation" carried two 25-ton guns in each of her turrets; she was of 9,330 tons displacement and at that time was the most powerful warship afloat. Another improvement which had now become general was the introduction of the double bottom and the division of the ship into a number of watertight compartments, which all tended vastly to increase her power of remaining afloat in case of serious injury. Six years before the completion of the "Devastation" the British flagship in the Mediterranean was a wooden three-decker and thirteen years before, there was no sea-going armored ship afloat. Therefore the change that transpired in this period, brought about by the battle of the "Merrimac" and the "Monitor," is the most wonderful and startling in naval history.

In 1875 England and most other nations had entirely abandoned the construction of broadside battleships. In 1881 the "Inflexible" the first of what is known as the citadel type of ship, was built in England. This was also the last ship of the naval powers to carry muzzle-loading rifled guns and to be protected with iron armor.

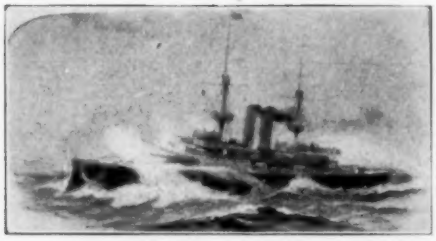
France, Russia and Germany followed each other in close succession in the adoption of breech-loading ordnance in the latter part of the seventies. England and the United

A Notable Departure in Turret-Ship Construction: H. M. S. "Devastation" Armed with Four 25-Ton Guns, Two in Each Turret, Launched 1872

States were tardy in this improvement. In 1882 builders of warships began the mounting of heavy guns in barbettes instead of turrets, and the construction of a broadside battery for 6-inch quick-firing guns between the barbettes. This supplementing of the heavy guns of ships by a secondary battery of lighter guns had been rendered necessary by the advent of the torpedo boat and to the necessity of meeting the attacks of these formidable little vessels we are indebted for the rapid development of the quick-firing system, which has been one of the marked features in the improvement of ordnance in the last few years. The



Battle of Yalu River, 1894.--The First Real Test of Modern Ironclads in Action



Model of Most Modern Type of Battleship: H. M. S. "Royal Sovereign"

barbette has since been definitely adopted in place of the turret. When the guns were mounted in turrets, the turrets revolved, carrying the guns with them. Where the guns are mounted in barbettes, the guns are on turntables which revolve with them inside the barbette, which is itself a fixed heavily armored redoubt, the guns firing over the top. The great advantage of the barbette system is that the guns are carried much higher out of the water. In the earlier ships the guns were exposed and were thus liable to injury from the enemy's fire. This defect has been remedied by protecting the guns with heavy steel hoods, which revolve with them.

The "Royal Sovereign" class of battleships, built in Great Britain through the passing of the Naval Defense act in 1889, formed a model after which vessels of most every country have since been built. These craft have a displacement of 14,150 tons. They are 380 feet long, with a beam of 75 feet and carry four 67-ton guns in barbettes. Protection is afforded by an 18-inch waterline belt running for two-thirds the length of the whole ship, terminated at each end by 16-inch armor transverse bulkheads. At each end of this are the armored citadels for the barbettes, protected by 17-inch compound armor, the barbettes themselves being similarly protected, while armored ammunition tubes are carried down from the turntables to the top of the armored deck. This arrangement precludes the possibility of the bursting of shells under the floors of the barbettes, upon which the revolving gun platforms are carried. Between the barbettes the side is protected to the height of the main deck by 5-inch steel armor. Further protection is afforded by a 3-inch armored deck resting on top of the belt.

In 1893 new styles of battleships were built in America and England. They are simply an improvement on the "Royal Sovereign" type. In England they are known as the "Majestic" type and on them a uniform thickness of 9-inch armor of Harvey steel is substituted for the compound armor and thinner belt above the earlier ships, the whole depth of the armor in these ships being 16 feet, while the armored deck instead of being flat on top of the belt, curves downward on each side to the lower edge of the side armor, and as it is four inches thick, it adds enormously to the offensive resistance of the ship. In later built ships the disposition of the protective belt is practically the same, although in the armor which is now made of hard Krupp steel, it allows of a greater surface of the ship being protected. The armament, however, is the same—namely, four 12-inch guns, twelve 6-inch quick-firing guns, sixteen 12-pounder quick-firing guns, with some smaller ones, while they generally have four submerged tubes for discharging Whitehead torpedoes.

Even more powerful, but still heavier ships are now being built. The greatest are those of the "King Edward VII" type under construction in England. In them the displacement has been raised to 16,500 tons, while four 9.2-inch guns have been added to the heavy armament and are carried singly in small turrets, two on each side of the upper deck. It is reported that a still larger type of ship is to be built in England with a displacement of 18,000 tons. Should this be done the additional tonnage will probably be used to mount eight instead of four 9.2-inch guns, while the armor protection will be increased so as to cover nearly the whole hull.

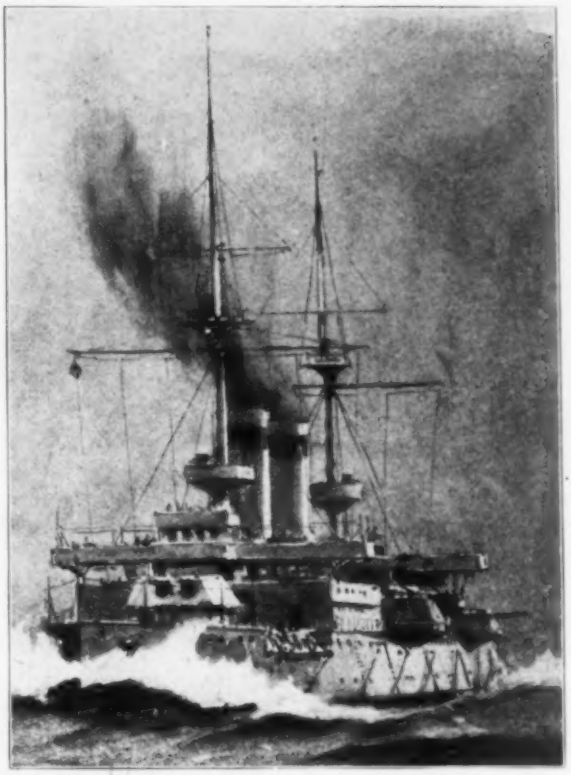
The "Petropavlovsk," Admiral Makaroff's flagship, which was destroyed at Port Arthur, April 13, was not as powerful as the late English and American built vessels, but she was one of the most formidable in the Russian fleet and a type of modern armored vessels. She was of 10,960 tons displacement and carried four 12-inch guns in her main battery. She was built in 1895.

With all her armament and powerful guns the "Petropavlovsk" was helpless against the mines or torpedoes by which she was destroyed. The cause of her destruction is not yet known. Some claim that it was by a Russian mine, some that it was by a mine planted by the Japanese, and some that the vessel was torpedoed by the Japanese. It will require a future investigation to accurately determine the cause. This much is known, however, that the "Petropavlovsk" was one of the Czar's greatest ships built at an enormous cost and that she was sunk almost instantly by some small machine of

comparatively insignificant cost. And the "Petropavlovsk" while affording the greatest loss that has yet been encountered by the Russians, is only one of the victims of the submarine explosives. Following are others similarly destroyed or damaged:

The "Czarevitch," battleship, torpedoed at Port Arthur, Feb. 8; the "Pallada," cruiser, torpedoed, Feb. 8; the "Askold," torpedoed, Feb. 8; the "Yenesei," transport, blown up by a mine near Port Arthur, Feb. 12, and 95 men perished; the "Boyarin," cruiser, blown up by a mine, Feb. 16, 195 men losing their lives; the "Steregoutchi," destroyer, sunk by torpedo, March 10, "Skori," blown up by mine.

With such a list of recent casualties, it is not to be wondered at that some people are beginning to wonder if the day of the great battleship is nearing an end; if the little submarine machine is not more destructive than the mightiest man of war a nation can build. Some have declared that the greater battleships only serve to give an enemy a chance to inflict greater loss. As nearly every other war has worked sweeping changes in the mechanism of fighting machines, it is not to be expected that the Japanese-Russian war will be an exception to the rule. Many naval experts claim that it has already taught the lesson that the future battleship must be a smaller, lighter craft, capable of great speed and with better equipment for avoiding the attacks of torpedoes. It would seem to us, however, that the great battleship still has its uses, and that no other fighting machine can take its place; but that a nation's navy should also be equipped with an ample number of cruisers, torpedo boats, torpedo boat destroyers, and swift moving vessels specially equipped for speedily laying and destroying mines. There is no doubt that naval battles of the future will be fought largely under water, but the great steel armored vessel will still be the main protection of the nation and the backbone of the navy.



Latest Design of English War Vessel--The "King Edward VII" to be the Greatest Battleship Ever Built

CARS SWITCHED BY GRAVITY.

In many of the large terminal and division yards in the United States, cars are now switched by gravity. In some cases a receiving yard is done away with entirely, the cars being run over a hump at the head of a yard and switched to the tracks on which they belong according to their destintions and the character of freight they carry. In this way hundreds of cars are handled expeditiously and systematically every day.

Perhaps one of the best arranged "hump" yards is the yard of the Pennsylvania line located at Altoona. Here the main westbound freight line divides into two tracks which pass over the scales and hump and 800 feet to the lead switch—from which point the cars are carried 2,000 feet. There are 15 classification tracks in all. At this yard 1,491 cars have been handled in 24 hours; one day 984 cars were handled in 12 hours. This hump has a grade of 4 per cent for 200 feet.

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The Diver's Life is Full of Perils

Accident to William Hoar, However, the Worst in the History of the Business

By Capt. Andrews, New York's Veteran Diver

Men who make their living by toiling under water and breathing air pumped to them through a tube have met with many frightful experiences, but none with a more horrible fate than that which befell William Hoar at Boonton, N. J., a short time ago. Hopelessly pinned in the suction of a 4-foot outlet pipe, 65 feet under the surface of the new Boonton reservoir, Hoar's almost titanic strength gave way only after 22 hours of what must have been excruciating mental and physical agony. Hoar was known throughout his profession as an experienced diver and as a man of extraordinary endurance.

I have heard of a good many blood-curdling scares and fatal accidents and squeaks that would turn your hair gray, and I have had several narrow escapes myself, but poor Bill's scrape discounts them all.

Diver in Armor

One of the toughest accidents on record happened to a diver who met Hoar's fate about six years ago down in a 50-foot mill dam at Holyoke, Mass. The dam had sprung a leak near the bottom of the lake and a cataract of water as big round as a beer keg shot through the masonry and threatened every moment to enlarge the aperture and take the whole wall with it. The only hope to save the dam was to stop the leak by means of bags of Portland cement, and a diver was sent below to make a preliminary survey. He never so much as signaled. No sooner had he touched bottom than there came a quick vicious tug that almost hurled the tender into the water; then all was still save the air bubbles which rose to the surface, showing where the escape in the helmet was doing duty in releasing the used-up air pumped down through the hose to the man below. In vain the tender signaled, again and again inquiring whether all was well. There came no answering tug on the line, and when the combined strength of three men failed to budge the fellow underneath, another diver was sent to investigate. He found his mate doubled up, chin and knees together, hopelessly wedged six feet deep into the aperture. Not a sign of life was in the unfortunate man, nor was it possible to budge the body, which afterward was entombed by cementing up the hole.

Here in New York harbor we have about as many narrow shaves as come to men in most parts of the country. A brig, the Chatfield Taylor, had "touched" one day on her way into port. According to the laws of the underwriters she had to be inspected before going back to sea. The vessel was anchored over in the mud flats off Communipaw, and I put off one of the coal docks, intending to walk out the hundred feet or so and examine her bottom. Everything seemed in perfect working order as I started. I could hear the regular, everlasting "click-click-click" of the triple-barrelled air pump and felt each gust of air as it came through the goose neck at the back of the helmet. Suddenly I started. The clicks had ceased abruptly. Something had gone wrong. For an instant I stood stock still scarcely able to believe my ears. I felt a thrill shoot through me from heels to hair. It was my first serious accident and in a moment I had lost my head and was all excitement. I forgot even to signal to be hoisted by the life line. I dared not stand up in the current, which would have swept me off my feet, and so I crawled back on hands and knees, following the line and the hose, all the time feeling the pressure of water increasing as the air escaped out of the helmet.

My hands and legs and trunk seemed to be grasped as if in a vice, and blood was being pressed to my head until my nose began to bleed and I grew giddy and weak under the strain of fear and scarcity of air. What might have happened is not hard to tell. But just as I was ready to give up, I felt a pull of the life line and then felt myself being dragged swiftly upward.

I was unconscious when pulled out and was bleeding at the mouth and nose and ears. My eyes had begun to start from their sockets. For a month I lay in a hospital, my face black with clots of blood

that had been driven up through the pores, and the whites of my eyes looking like burnt holes in a woolen blanket.

What had gone wrong? The hose I had used had been repaired and during the process some cement inside the tube had rolled itself into a ball along with dust and other foreign matter from the shops. When the air was started everything worked well, but after a time this ball was driven forward to the next coupling, where it lodged and stuffed the hose, cutting off all air. If the pumpers had not noticed that the air was forcing harder and harder and that the air gauge showed an excess of the required amount, I would not have been pulled out in time. As it was, for more than a year I could pinch my face, cheeks, chin or forehead and pull tiny bits of congested blood out of the skin.

Divers at Work Trying to Release William Hoar at Boonton, N. J.

A brave fight for life was put up by a poor fellow while working for the Baxter Wrecking Company on a three-master, sunk off West 38th street, New York. In some way Woods' hose and life line became entangled so that he could not signal. It was found afterward that both strands were wound about the fluke and anchor. What happens to so many divers when in serious trouble, happened to Woods. He lost his head. Had he remained perfectly still, the chances are that repeatedly unanswered signals from above would have brought help, and he might have been freed of his predicament. But in his fright he tried to cut himself free, to sever the life-line in the hope of being able to untangle the hose. Not succeeding, he did the most foolish thing he could do under the circumstances—he drew a jack knife out of his overalls and began to slash at his hose.

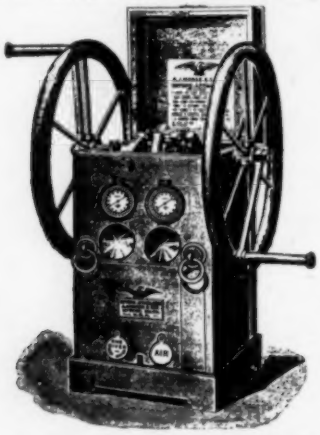
On shore, or in daylight, he would have had little trouble cutting through the rubber in three or four successive slashes, but down in the darkness of the river bottom he could not keep his blade in the same place for two successive jabs, and he simply punctured that hose in a half dozen places, rendering it useless and cutting off his supply of air. Later he was brought up by his own brother, and his face and head were mutilated frightfully by the terrific pressure which had forced blood upward until his very eyes were driven out. Up in the Baxter Wrecking Company's offices they will show you that same piece of slashed hose to this day.

Probably Popular Mechanics' readers would like to know something about the equipment of a diver; the kind of clothes he wears and how he goes down into the water and remains there.

With the screwing on of his brass helmet a diver hands his life over to the keeping of his attendant and the men at the air pumps. Submarine diving is the hardest kind of work, requiring experience, skill, ingenuity and plenty of nerve. The occupation, however, is often exciting and commands good pay.

An outfit for diving in moderate depths includes the following articles: Air pump. $250; diving helmet, $100; two rubber dresses, $80; 150 feet air hose, $54; pair diving shoes with lead soles, $12; two pairs diving mittens, $10; two pairs diver's stockings, $2.50; pair sleeve expanders, $5; basket to pack helmet and suit in, $15, and numerous bolts, nuts, tools, etc., which bring the outfit up to $574. An outfit for very shallow work may be had for $375, while deep sea outfits cost $725, and up. This article will describe the dress and how a dive is made.

The diver, having taken off his own shoes, puts on a diver's flannel shirt, a pair of



Morse's Double-Action Air Pump, for Supplying Air to Divers

diver's drawers, carefully adjusted and drawn up outside the shirt, then his heavy stockings. If the water is cold he puts on two or even three suits of underclothes. If going into very deep water, cotton saturated with oil is put in the ears and a crinoline cap drawn down tightly over the ears. A pad is strapped on the shoulders to relieve the weight of the helmet and frame. He then gets into the diving dress, which in cold weather must first be warmed, drawing it well up to the waist; an assistant opens the cuffs with the sleeve expanders, the diver pushing his hands through. He then puts on his canvas overalls to protect the rubber suit.

The diver now sits down, the inner collar of the dress is drawn tightly and tied with spun yarn, and the breastplate carefully put on. This is in two parts, between which the neck of the rubber suit is tightly clamped. The shoes, weighing 10 to 20 pounds each, are now put on and strapped. If rubber mittens are to be used, they are next clamped to the cuff rings. He is now ready for the helmet, which is fastened with clamps or screwed on, according to the type of helmet. These helmets are made of tinned copper, with all mountings in finest gun metal, having three windows or lights of heavy plate glass, and are large enough to allow the diver to turn his head. In the Morse helmets, such as are furnished the navy, a safety valve prevents water coming into the helmet (and instantly drowning the diver) in case the air pipe is cut. An escape valve permits the air to flow out, thus maintaining pure air for the diver. A safety lock prevents the helmet becoming accidentally unscrewed.

The helmet is now adjusted in place, but the front plate is left off to admit air. The life line is next tied around the waist, brought up in front and secured with a bit of rope around the neck. The waist belt is buckled on with the knife on the left side, and the air hose screwed into the helmet. Two men are now ordered to "man the pumps." The diver steps on the ladder which extends a few feet down into the water and the weights are put over the shoulders.

The attendant now makes a most careful and final inspection, and if everything is right, gives the word "Pump," and screws on the front plate. Air now begins to discharge through the escape valve in the helmet. He then takes the life line in his hand and "pats" the top of the helmet with it, which is the order to the diver to descend. While the diver is below no laughing or talking is allowed, and the attendant must keep the life line in hand every instant. Some divers have a rope ladder reaching to the bottom, but experts prefer simply a rope heavily anchored as a guide down. After descending a few yards a halt is made to make sure everything is in proper working order. If he feels oppressed he must rise a yard or two, swallow his saliva several times and not go down until he feels comfortable. If oppression, headache, or singing in the ears continues he must return slowly to the surface. To dive to great depths, such as 120 or 150 feet, requires men of great practice and able to sustain the consequent pressure.

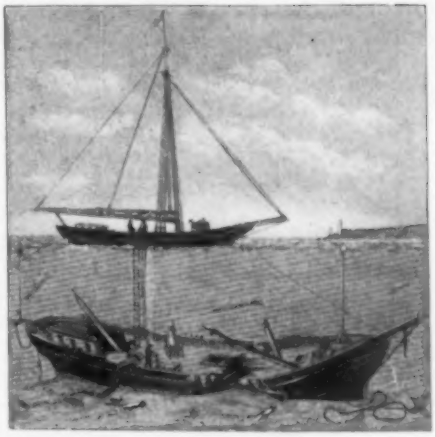
On arrival at the bottom he signals "All right," which is one pull on the life line. If he has to move away from the bottom of the ladder rope in thick water, he must carry a rope with him tied to the ladder rope to find his way back. If he loses his way, he must at once signal to be drawn

up. In traveling on the bottom he must return by the same path he went to avoid getting his air pipe and life line fouled around some obstacle. Where a diving telephone is used, orders are spoken after calling with a signal on the life line. One transmitter and receiver is fastened inside the helmet, and another set is beside the attendant. The telephone wires are inclosed in rubber and fastened to the life line. While the diver is down the attendant must frequently get an "all right" signal through the telephone or by the life line. If no answer is received the diver must be hauled up at once. In returning from great depths it is more important to rise slowly than in going down. The ascent from 120 feet should occupy five minutes in order to get accustomed to the great change in pressure from that depth to open air.

Two hundred and four feet beneath the water's surface is the greatest depth ever attained by a submarine diver. This was made possible by the latest improvements in armor, air supply, weights, life-lines, etc. In an effort of a diver to reach a wreck in 240 feet the diver experienced serious trouble at 130 feet and lost consciousness soon after passing the 200-foot depth.

These are some of the pressures per square inch at various depths: 20 ft., 8⅛ lbs.; 30 ft., 12¾ lbs.; 40 ft., 17¼ lbs.; 50 ft., 21¾ lbs.; 80 ft., 34¾ lbs; 100 ft., 43½ lbs.; 150 ft. (limit), 65¼ lbs.; 204 ft. (greatest depth any diver ever descended) 88½ lbs. For great depths the air pumps are driven by steam power instead of by hand. From the pressure indicated on the air pump gauge, one can easily calculate the depth at which the diver is working. The armor and weights will weigh 240 pounds.

The first time a man descends under water he is usually suffering from inherent nervousness, occasioned by the fact that he is engaged in an occupation hitherto unknown to him, consequently there is an increased pulse and peculiar gasping for breath; should these symptoms be marked it is not advisable, while in that condition to allow a man to descend. When the nervousness is overcome and the man calm, have him descend very slowly, swallowing his saliva and not demanding too much air, resting at times to recover his equilibrium; and if the pressure should cause too much pain in the head, gently ascend a few feet, and the descent can then be continued.



Divers Working on a Sunken Ship

The constitution of the diver will regulate the manner of his coming up. A man at all sanguineous should ascend slowly; the brain being suddenly relieved from the pressure causes a rush of blood to the head, and it may cause serious consequences. We would advise that a diver, a strong constitutioned man, should not ascend at a rate of over two feet every second. This course applies only to depths not exceeding 80 feet; greater depths require more care in ascending and more time in coming up, according to the increase in depth up to the limit of 150 feet. In ascending from very deep water, the diver having been in a condensed atmosphere, time should be given for the muscles and tissues of the body to be relieved of the pressure by very slowly ascending, or frequently stopping for a time at certain stages, to allow the body to be relieved of the greater pressure acquired while working

Helmet and Telephone Attachments--Latest Equipment for Divers

in the denser atmosphere, or to establish, as nearly as possible an equilibrium between the pressure absorbed and the actual pressure of the water he may be resting in.

No diver should take any food for at least two hours before commencing operations. If any kind of refreshment be required, a biscuit, or dry cracker, with a small amount of fluid, or anything that will not excite the digestion, may be taken during work.

An eminent medical authority says: "The men who work subject to great pressures should not eat one ounce more of animal food than is needful to maintain their strength, as, in my opinion, should they eat too much, it increases the tendency to apoplexy. The bowels should be kept regular, as when they are unduly gorged they press upon the diaphragm, obstruct the action of the lungs and respiration, which leads to an embarrassed circulation of the blood and a whole series of evil results."

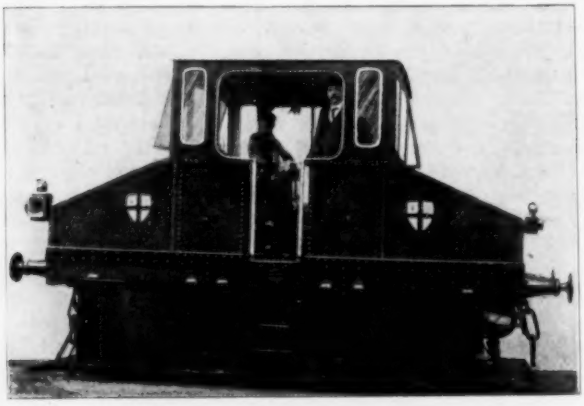
From an experience of many years, we have no doubt that diving is not injurious when conducted under ordinary precautions, and we have known of instances where divers, who in their youth were sickly, have become strong and well, which can only be attributed to the effect of compressed air upon their lungs, and the body in general, as absorbing a greater amount of oxygen from the compressed air. It also promotes digestion, owing to the greater quantity of oxygen carried into the blood.

Before a man attempts diving he should have a medical examination. Those who come under any of the following classifications should not undertake diving: Men with short necks; full blooded; who have headaches or are slightly deaf; who have spit blood or have palpitation of the heart; men with bloodshot eyes or high color in cheeks; men who are hard drinkers, or who have had rheumatism or sun stroke.

Thus we see the dangers found in this occupation are vastly more within the man himself than attacks from without by sharks and other monsters of the deep that we have been accustomed to read about.

Largest Gasoline Locomotive Ever Built

A gasoline locomotive is doing the work of a switching engine on a steam railway in London, England. Although in operation only a short time the work is pronounced very satisfactory, and as only one man is required to operate the machine, and the cost of fuel is less than for steam, the engine is effecting a large saving in money. On account of running in the city, the speed is geared down so it cannot exceed five miles an hour. The engine has three cylinders, each 9 by 9 inches, working at 450 revolutions per minute and develops 80 horsepower. This is sufficient to draw four loaded cars. The locomotive weighs 12 tons, has air brakes, and carries a fuel supply to last one day. The motor is cooled by fans.



Maudslay Petrol Locomotive

LEARN TO MAKE YOUR OWN FURNITURE.

That every householder may be his own furniture maker, if so minded, was declared proved by the South Park Workshop Association, Chicago, at a recent exhibition. Specimens of work done by members of the association consisted of nearly every article of household furniture. Exhibits of work done by children from 9 to 16 years old comprised school boxes, tools, plant stands, book shelves, etc. The association is supported by membership fees and maintains a workshop equipped with benches and tools for woodworking. Not only do business men gather at the shop, but their wives and children as well.

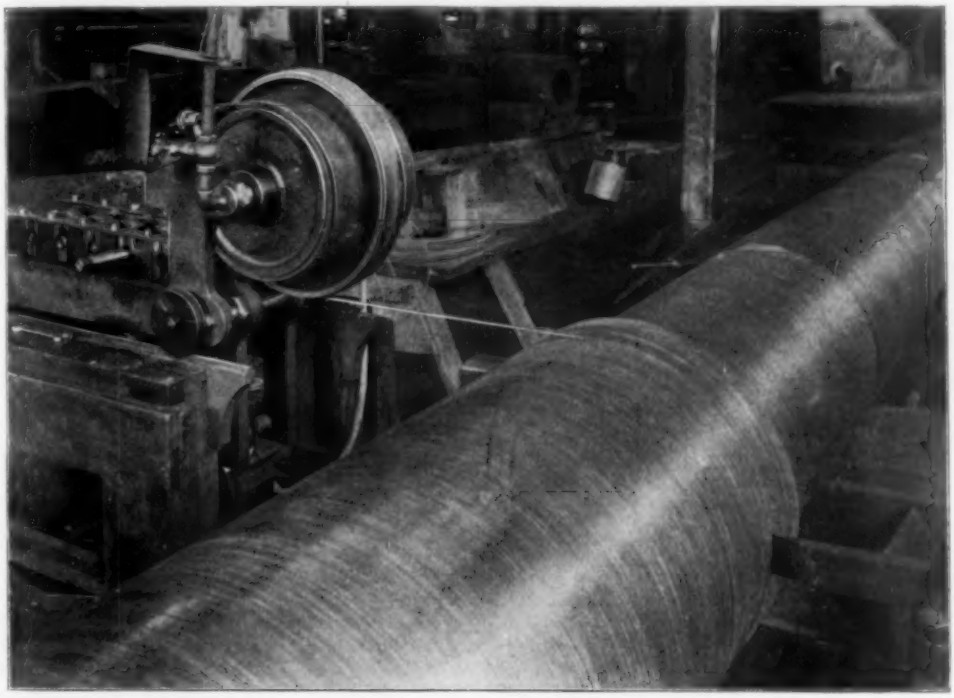
Future Gun May Shoot 100 Miles

New 6-Inch Type Will Pierce a Ship 30 Miles Away and Others Even More Powerful Will Be Built

A flash of fire; a sharp, loud report; a shot speeding through space at the enormous velocity of 3,500 feet a second; a hole bored through the steel side of a battleship 30 miles away. This is the work, experts say, can be done by the new 6-inch Brown wire tube gun that has just been built for the United States government. No gun like it was ever constructed before. It is the most powerful weapon of its size ever devised by skill of man. Think of it! A 6-inch gun which, if stationed at the Chicago harbor, would hurl a shot that would pierce a ship more than half way across Lake Michigan, or 30 miles away!

But this is probably but the beginning of a new era in gun manufacturing that may make the American gun more famous than the Krupp and that may prohibit any hostile ship from coming within 100 miles of our shore, for it is claimed that a larger type of this new gun will shoot 100 miles and larger types are to be made.

The 6-inch Brown gun has just been completed for a test at Sandy Hook. After its successful test, the national government will order made 24 more guns of the same size in addition to twenty-five 5-inch guns, there being $700,000 available for this purpose. The gun just completed is 26 feet long and weighs 20,000 pounds.

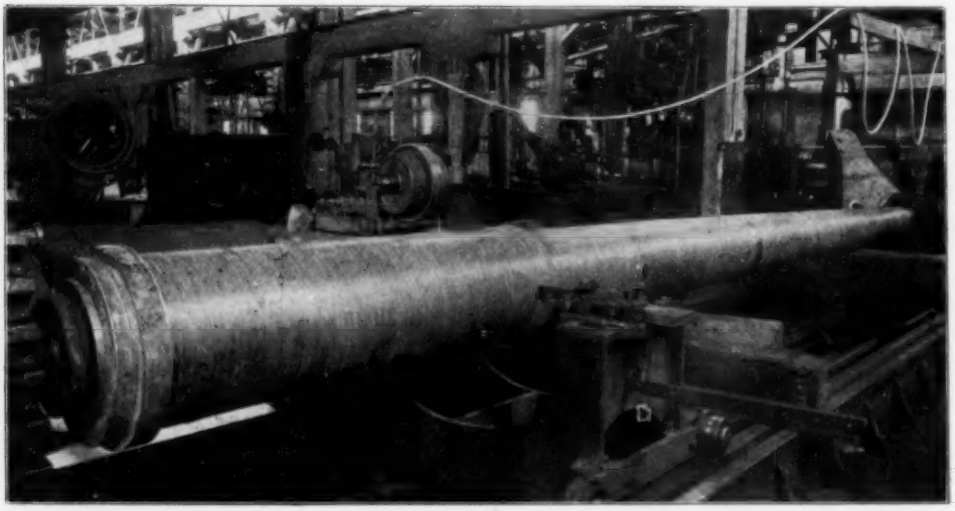


Winding 20 Miles of Steel Wire Into the New Wire Gun

One of the chief features of this great gun will be the obviating of the dangers from explosion which have so often occurred in the past history of warfare. The inventor claims that it will be impossible to explode this gun with gunpowder, no matter what the pressure. It is built to stand 50,000 pounds pressure to the square inch at the muzzle and 100,000 pounds to the square inch at the breech. Thus the muzzle strength of this gun is greater than

the breech strength of the guns now in use in the American army and navy.

The gun is built of rolled steel sheets upon which are wound layers of polished steel wire. The lining tube is of forged steel. Next comes the involute wire sheets.



Scene in the Reading Shops, Where the New Wire Gun Has Just Been Completed

Over the steel sheets more than 20 miles of square steel wire is wound. Over the wire is shrunk a trunnion jacket of forged steel. There are seven layers of wire at the muzzle and 21 at the breech. One of the accompanying photographs illustrates the manner in which this wire is wound by machinery. The tension in winding is about 128,000 pounds to the square inch. It is the tensile strength and elasticity of a gun built in this manner that gives to it great advantages over all other guns. The inventor of this gun is J. Hamilton Brown and the work is done at Reading, Pa. The manufacturer states:

"The possibilities of guns of this kind are marvelous. It is estimated, for instance, that a 10-inch gun will throw a shell nearly 60 miles and that a gun of larger size and of this pattern will throw a projectile 100 miles. All this is quite in contrast to guns made years ago and especially those used before the Civil War, when they were often made of a single piece of cast iron. While wire-wound guns are not altogether new, the Brown gun differs from all that have ever before been used in many important respects."

ALUMINUM USED FOR LETTERS AND FIGURES.

Aluminum letters and figures, light, durable, cheap and easily procured, are coming more and more into use, and are superseding brass in many instances where that metal was formerly used. For show window lettering they have qualities which commend them above letters of any other metal or material heretofore used. They do not easily tarnish, peel off, crack or break; they can be attached to almost every substance used, wood, brick, stone or metal, and if one should become broken, they are now of such general use, that it could be matched and replaced from the local market. These letters and figures are being used for street numbers, door plates, numbering machinery in large plants and in many other places.

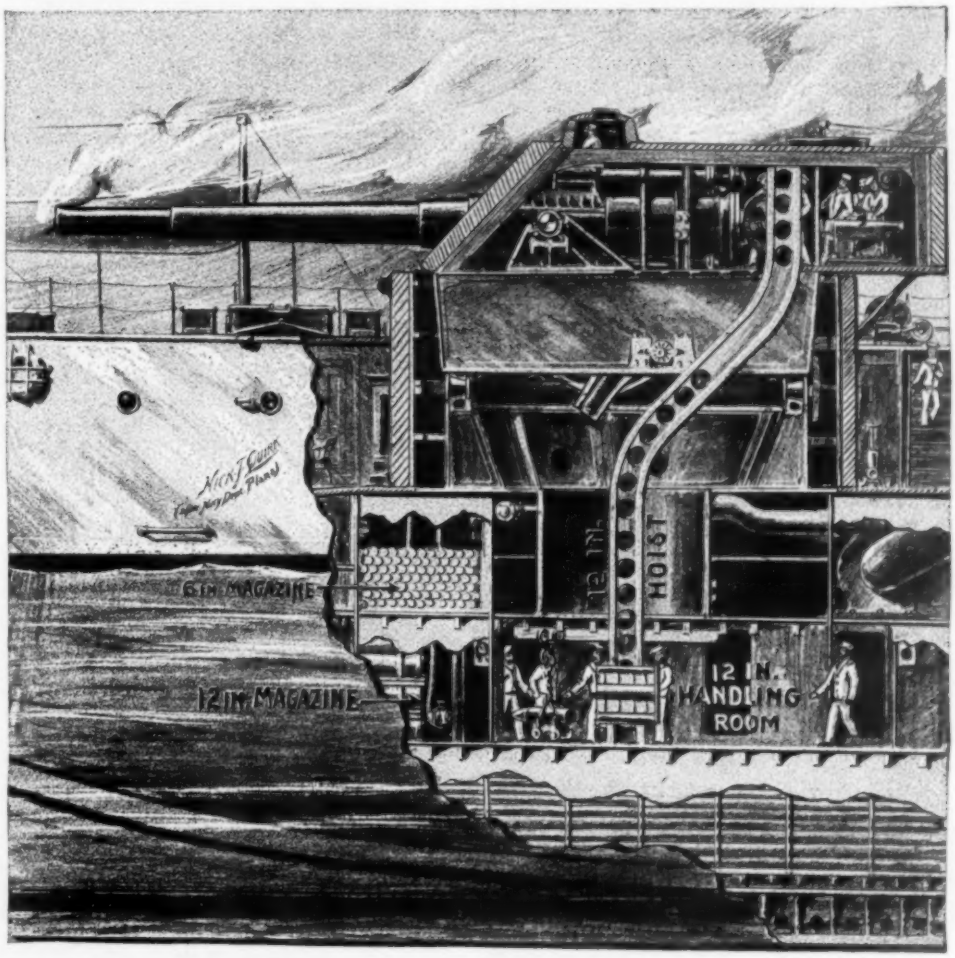
The aluminum supply is increasing, with a consequent reduction in price. It is so light that its volume per pound is three times that of steel. Its tensile strength for a given weight is 8,000 pounds greater than that of steel, or 78,000 pounds.

The total number of men under arms in the world is approximately 5,500,000, not counting reserves, marines and sailors in the navies. The total cost of the military and naval establishments of the world for one year is approximately $1,681,768,000.

The Lesson of the Missouri

Are Modern War Vessels as Dangerous to Their Own Men as They are to the Enemy? Is a Naval Victory Now as Dangerous to the Victor as to the Vanquished?

Another terrible naval accident has resulted in the death of 33 officers and men on the Missouri, America's newest battleship. It was caused by the explosion of 2,000 pounds of powder and is the fourth serious accident to guns of United States battleships in about a year. The news of the explosion was flashed over the world at about the same time that the British torpedo boat destroyer Teazer was wrecked by running into a sea wall at full speed and shortly after the British submarine "A 1" was sunk in Portsmouth harbor with its entire crew of eleven officers and men. The disasters to vessels in peaceful harbors seem almost as numerous as those in the belligerent waters where war is being waged between Russia and Japan.



Sectional View of the Battleship "Missouri" Showing the After Turret During the Loading and Firing of a 12-inch Gun—The Greatest Loss of Life Occurred in the Handling Room Where 1,600 Pounds of Powder were Exploded.

Such accidents and their frequent occurrence leads to the question: Are modern war vessels as dangerous to those operating them as they are to the enemy? Many can be found who will contend that they are. In fact most of the disasters that have befallen the Russian vessels have been self-inflicted. It has been often remarked that Russia has proved her own worst enemy and is about to defeat herself. Modern ships are seemingly about to prove inadequate to the strenuous duties demanded of them and the hazardous dangers they are forced to encounter from many sources.

The great loss of life occurred in the aft turret and the handling room during the loading and firing of a 12-inch gun. Four hundred pounds of powder exploded in the turret and 1,600 pounds in the handling room. Most of the dead were in the handling room, a compartment immediately underneath the turret where the powder charges are brought from the magazine and placed in the hoist to be sent to the turret. There is a stringent order issued by the navy department prohibiting more than one powder charge being in the turret at any one time; that is, until the gun has been fired and the breech block opened for the reception of the new charge, the latter could not be sent up from the handling room below. The construction of the Missouri, however, rendered this order nugatory. The floor of the turret of the Missouri is not solid but is merely a grating. The turret and the handling room, practically, formed a single compartment and, when the great burst of flames swept out from the breech of the gun and shriveled the men there like so many pieces of tissue paper, it found its natural vent through the grating and continued the work of destruction in the handling room.

What caused the powder to ignite, is the question that is puzzling the navy. Some say it was from the heat of the gun from rapid firing; some that it was caused by "back fire," which is supposed to be flame that hovers near the gun after the fire and then is blown back into the gun by a shift of the wind; many believe the accident was caused by the premature ignition of the powder charge by a fragment of the canvas bag, or by a grain of powder still smouldering when the new powder charge was rammed home.

The powder charge for a modern gun is encased in a canvas bag. When the gun is to be fired the shell is first put in and then the powder charge, 360 pounds for a 12-inch gun, in four bags of 90 pounds each. In the old days of the smooth-bore and breech-loader, which burned black powder, the gun was swabbed out to prevent any fragments from remaining in the gun when the new charge was put in. The modern theory is that in loading the shot, which fits closely to the bore, it drives everything before it, and, hence, that there is no danger of a fragment being left. Many officers, however, believe that the theory has not been absolutely established, and they think that a fragment of smouldering cloth could lodge behind the shell and would not be detected in the haste of loading and firing.

Americans hold the world's record for accuracy and rapidity of naval gun fire, but it is costing us dearly. The strain upon the nerves even during a practice of rapid firing, is most intense and of course, it would be much greater during an actual engagement. The accident to the Missouri has caused naval officers to discuss the effect of a naval battle under modern conditions and to await with keen interest reports that shall show whether the morale of the Russians and Japanese has been broken down by the tremendous strain upon their nerves. Many now contend that a naval engagement will be almost as disastrous to the victor as to the vanquished. The terrible shock of the impact of a 13-inch shell against the side of an ironclad even if it did not destroy the vessel, would cause such a terrific concussion and so affect every nerve that men would be inefficient when the reaction set in after the battle.

Crossing the Sahara in an automobile will be one of the interesting features of a 20,000-mile automobile trip around the world to be undertaken by Mr. Glidden of Boston. Two seasons are to be devoted to the trip, the party returning to Boston from Athens at the end of the first. Many of the great cities of the world are included in the route.

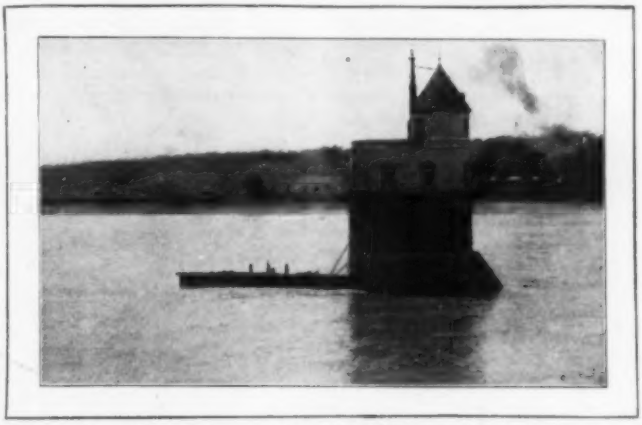
To relieve burns and scalds cover the injured place with cooking soda and lay wet cloths over it. Whites of eggs and linseed or olive oil; olive oil or linseed oil, plain, or mixed with chalk or whiting; sweet or olive oil and limewater are all good remedies.

The Interstate Commerce Commission report shows that 1,166 persons were killed by railroads in the United States during the three months of October, November and December last. Of these 175 were passengers and 991 employes.

St. Louis Water Problem Is Solved

World's Fair Visitors Find the Purest Water in a City Famed for Its Foul Drinking Supply

St. Louis' drinking water, long regarded as the muddiest and filthiest of any city of the civilized world, has been purified. The problem that has puzzled that city for generations and has caused scientists to fear the fate of other large cities with increasing population has been solved. Such a transformation has been worked that instead of having the foulest water in America, St. Louis can probably be said to now have the purest water in America.



St. Louis Water Intake Tower in the Mississippi River at the Chain of Rocks--Pumping and Settling Reservoirs in the Distance

Visitors to the opening of the Louisiana Purchase Exposition, who had long heard of St. Louis' muddy water so laden with disease germs, were amazed when they drank such clear, palatable water. This was the most wonderful and welcome exhibition the world's fair city had to offer its visitors. It is the most splendid possession it can give to its present and future inhabitants. Not only is this achievement an invaluable blessing to the present and future generations of St. Louis, but it heralds a new day in the purification of all drinking water.

And to whom is credit due for this accomplishment? Who is the hero who has saved so many hundreds of lives of the young and the aged, of the living and the unborn? Ben C. Adkins is his name. He is St. Louis' water commissioner. There is a man named Folk who gained worldwide renown for cleansing St. Louis' politics of its pollution. He saved the city's reputation. There is a man named Adkins who cleansed St. Louis' drinking water, fouler far than its politics. He has saved the city's lives. Let men revere them both, for the work of both has been great and noble.

Mr. Adkins' accomplishment is in every respect a most complete success, for not only has he given to the city drinking water that is absolutely pure, but in so doing he has not added to the burden of the taxpayers. His process is as simple as it is successful—so simple that it is a wonder St. Louis and other great cities had not thought of it before. But thus it is with all great discoveries and inventions. Mr. Adkins has given the city pure water at a cost of less than $2 per million gallons. Instead of a mammoth system of filtration plants costing many millions of dollars, such as has been proposed, and such as other cities have built, Mr. Adkins has purified the water, using the same plant with slight and inexpensive alterations. The system is a simple chemical and mechanical treatment which removes all the suspended matter and germs from the water. Sulphate of iron is the principal of the chemicals and a solution of lime is its sole assistant. The chemicals are obtained from the American Steel and Wire Company, which has rendered Mr. Adkins valuable assistance in his successful undertaking. Neither Mr. Adkins nor the American Steel and Wire Company has patented the process and it is free to the world as their gift to humanity.

Most unique is the action of the chemicals

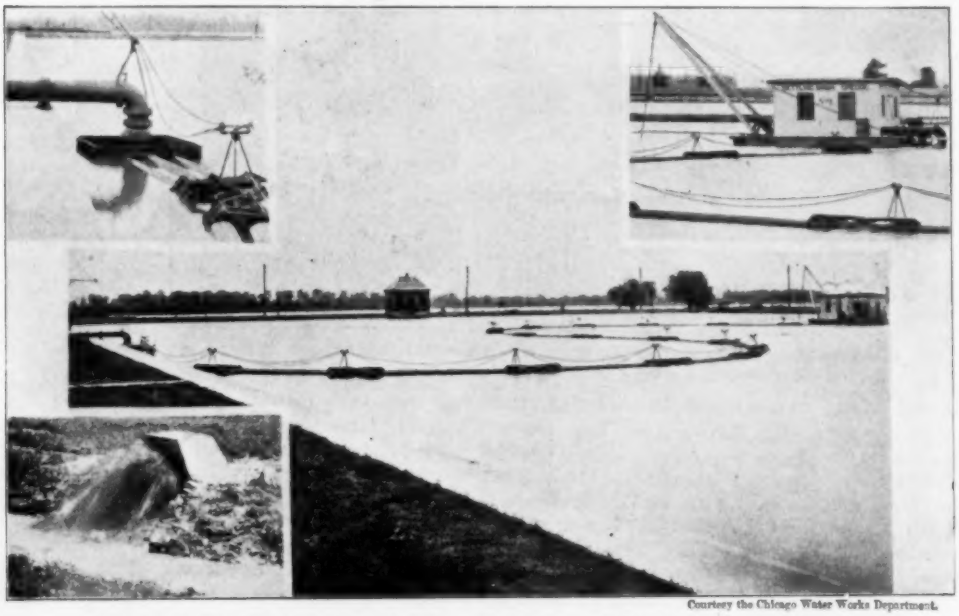
in ridding the water of its impurities. First the dissolved iron sulphate is injected into the suction conduit before it reaches the pump. The lime solution is injected after the water has passed the pumps. The reaction of these two chemicals is such as to combine with the carbonates in the raw water and unite the suspended matter into larger flocculent gelatinous masses, which precipitate rapidly in the reservoirs. During this process the disease germs become entangled in these sticky gelatinous masses and are carried to the bottoms of the basins and deposited with the sediment.

A very pretty illustration of this can be seen by taking a glass of dirty water, dropping into it a quantity of sulphate of iron equal to about two grains of wheat, then adding three or four drops of lime water and stirring freely for a few minutes. After standing a short period of time, these large gelatinous masses can be seen to form and precipitate, entangling in their sticky masses such germ life as may be found in the water.

The more germs and suspended matter there is to catch, the heavier the mass becomes and the quicker it is carried to the bottom. Thousands of cubic feet of this sediment is removed from the bottom of the reservoirs every few weeks, being readily flushed out through openings in the bottom of the basin leading to sewers.

At St. Louis the water works plant is arranged for the addition of filters. When completed, the water will pass from the reservoirs through sand filters; some of these light flocculent masses will be left in the water when it passes out of the reservoirs and will be used to form a coating over the top of filters and any remaining disease germs will be entangled in this gelatinous coating, which will remove the last vestige of these germs, and the work is then complete.

To demonstrate how the process plays havoc with the germs, tests have shown one cubic centimeter (about two drops) of raw Mississippi river water to contain 107,000 bacteria, practically all of which were removed in the thousands of gallons tested after the process of purification was completed.



Courtesy the Chicago Water Works Department.

New Hydraulic Dredge for Cleaning Settling Reservoirs

No water can become so foul from sewage or other cause that the new process will not render it perfectly pure. The cities along the Mississippi and Missouri rivers may now send all the refuse they want to toward St. Louis without impairing the health of the mound city's inhabitants.

Typhoid fever is caused by an intestinal germ called the bacillus colon, that comes

from the habitats of man, and is the most dreaded of all by physicians and chemists. This is the germ that has caused such horrible pestilence in the thickly populated cities of the world. This germ never appears in the wild woods or unsettled districts—it is only where people are numerous. The germs placed in water by nature are not injurious. Water of the Arizona, Nevada and Western Texas streams is healthful; but water flowing from big cities is dangerous. Filters will not destroy these germs, no matter how perfectly constructed they may be. The intestinal and other germs will follow water wherever it goes, unless entangled in a sticky substance as above described. If water can be forced through rock, the germs will go with it. The filter clarifies water, but does not rid it of germs. Hence the new chemical method would be of value to all cities and probably all will employ it in a short time. No germ can escape the myriads of little traps of the chemical process.

Noted scientists who have examined the iron and lime method have all acknowledged its unrivalled success.

St. Louis, in pursuance of the new system, is preparing for the construction of a new chemical plant. Contracts have been let with the American Steel & Wire Company for 3,000 tons of sulphate of iron during the next year.

St. Louis' preliminary success prepares the way for the establishment of a complete plant for sedimentation and filtration, which will undoubtedly be the most perfect water purifying system in the world and will metamorphose the conditions in the mound city.

Before the building of the hydraulic dredge system, the cleaning of the settling basins was done by emptying one basin at a time and washing the mud into the sewer by the aid of water siphoned from an adjoining basin and a large force of men with wooden scrapers, or with scrapers drawn by horses.

With the new settling basin dredge, shown in the illustration, the basins can be cleaned while in regular service. A centrifugal pump, electrically driven, is mounted upon a floating barge, and is provided with a suction pipe which extends to the bottom of the basin, and with a flexible floating discharge pipe which discharges over the side of the basin. The barge is 16 feet by 21 feet by 3 feet 9 inches deep and has a draft of about 26 inches.

The main pump is a 12-inch Morris centrifugal pump direct connected to a 90-horsepower motor. There is also a jet pump which furnishes a series of 13 jets at the mouth of the suction pipe by dislodging the mud. This is a 4-inch centrifugal

Courtesy the Chicago Water Works Department.

Great Settling Reservoirs of the St. Louis Water Works

pump direct connected to a 20-horsepower motor. The suction pipe of the main pump is 12 inches in diameter and expands at its lower end into a flaring or fan-shaped mouth-piece, having an opening 10 feet wide and about 1½ inches high, and provided with rollers which rest on the concrete bottom.

The electric current for operating the various motors is generated at the Baden station, a distance of 4½ miles, and is led to the dredge through cables supported by the floating pipes. The floating discharge pipe consists of 21 sections, each 21½ feet long, connected by 3½ feet of rubber hose. The discharge pipe proper is 14 inches in diameter and is supported by two floating airtight pipe 12 inches in diameter, one on each side.

Courtesy the Chicago Water Works Department.

Old Method of Cleaning Mud From Bottom of Reservoirs by Horses and Manual Labor.

The total amount of sediment deposited in the basins in one year amounts to more than 363,000 cubic yards. Of this amount 255,000 cubic yards were removed by manual labor up to the time of the establishment of the new system, at a cost of $3,158.51, or 1¼ cents per cubic yard. The enormity of the amount of sediment can better be realized when it is called to mind that a cubic yard is an average wagon load.

Although St. Louis' drinking water supply is obtained from the stream that flows between what are known as the banks of the Mississippi river, St. Louisans in reality drink Missouri river water and the Missouri river, by those who live along its course, bears the well earned pseudonym of the "Big Muddy." It is undoubtedly the muddiest, most turbid and treacherous stream in the United States. In its discontented, rapacious route it gathers up islands and banks, changing its bed many times in a decade, churning all into mud and hurrying it on to the Mississippi. The water that flows through the city pipes of St. Louis is pumped from a point four miles below the mouth of the Missouri river. Here anyone riding in a boat can plainly detect two separate streams of water flowing in the Mississippi's bed. One is dark as liquid mud and the other is fairly clear. The line that divides them is plainly discernible with the naked eye. One is the Missouri and one is the Mississippi; and it is from the muddy side of the river that St. Louis' drinking water is pumped. A pumping station, four miles below the mouth of the Missouri river, is at the Chain of Rocks, which is seven miles north of the Merchants bridge at St. Louis. The water is forced by pumps of 90,000,000 gallons capacity into a series of sedimentation basins, six in number, each basin being 19 feet deep, 600 feet long and

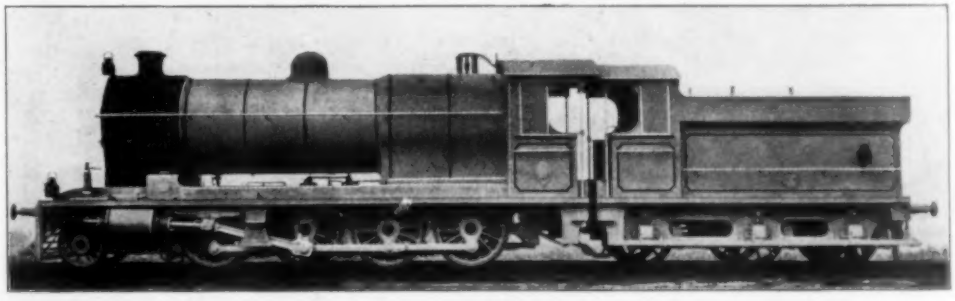
400 feet wide. It requires 48 hours for the water to pass through these basins and during that time the sedimentation is completed. The water goes in as muddy as the Missouri river and comes out as clear as crystal.

Extremely simple is this process in every detail and the cost is insignificant in comparison to other contrivances for purifying and clarifying water. Charged with both the sulphate of iron and the lime solutions, the water passes into the first sedimentation basin. Here the solutions quickly draw from the water by precipitation and coagulation the animal, vegetable and foreign matter, leaving but a small percentage to be extracted in its passage through the other basins and through the filter. When it shall have been completed, the chemicals form a coagulum, entangling the bacteria and suspended matter which are precipitated, and the subsequent rapid filtration of the water through sand will remove completely any remaining impurities. The sand used for this purpose is so selected that the component grains vary in size between certain optimum limits, determined by experiment. The river water normally contains more or less carbon dioxide, which holds in solution additional carbonate of lime. Thus the water is rather hard. Sufficient lime water must be added to neutralize the carbon dioxide and to unite with the iron of the ferrous sulphate. The iron is then precipitated together with whatever excess of carbonate of lime was present in the water. An increase in suspended matter obviously makes the coagulum heavier and it settles more completely in a given time. An examination of the iron contained in the water at the outlet of the basins showed that an increase in the amount applied to the raw water was not followed by a proportionate increase in the amount at the outlet, proving that the coagulant may be made to take the place of the suspended matter to a limited extent in the process of sedimentation. With turbid waters a purfiication of 98 to 99.8 per cent is obtained in the passage of the water through the first basin. On cleaning this basin after a period of from three to six weeks of high turbidity in the river, from 5,000 to 10,000 cubic feet of mud have been removed.

Observations on the occurrence of bacillus colon communis (disease germ) in the water further indicate the degree of pollution of the Mississippi river water by sewage. The typhoid germ is a normal inhabitant of the intestinal tract of man and also of many animals and occurs in large numbers in sewage. It is the opinion of sanitarians that the numbers of typhoid germs present within certain limits may be taken as an index of the degree of pollution. More typhoid germs occur in Mississippi river water than in any other prominent stream in America. In samples examined it was found that there were from one to 19 in a cubic centimeter (about two drops) of water.

Largest Engine in India

The largest engine on any of the 5-foot 6-inch gauge lines in India is a consolidation locomotive for service on the Bengal-Nagpur Railway. Its driving wheels are 4 feet 8 inches in diameter, its wheel base with tender is 48 feet; the boiler pressure is 180 pounds per square inch. The tubes have a heating surface of 2,062 square feet and the firebox 173 square feet, making a total heating surface of 2,235 square feet, while the locomotive's total weight is 150,080 pounds, or a little over 75 tons. The boiler has a copper firebox with copper stays and brass tubes. The reversing gear is placed under the boiler and is operated by a steam and water cataract cylinder.



Consolidation Engine for the Bengal-Nagpur Railway, India

Savings Bank That Cannot Fail

Largest Institution of the Kind in the World Conducted by the British Government

England's system of postoffice savings banks has prospered so phenomenally and met such a hearty response on the part of the public that the central institution, or general offices, in London has outgrown its big building in Queen street and moved to a colossal structure recently built in West Kensington. The new building covers five acres.

This is the biggest savings banking system in the world, although it is but a few years old. It is a bank that cannot fail, being part of the English government's postoffice system, and the public, knowing of its absolute security, has not been slow to tender its patronage. The people know that through this bank there is no danger of the hard earned savings of a life-time being swept away by some commercial misfortune, or through dishonesty of a banking official, conditions so common in America as scarcely to incite comment. The Englishman, when he puts his money in this bank, knows that he, or his heirs, will get it back with interest; no American possesses such assurance; he only hopes to get it back.

The general offices of this English savings bank employ 3,200 clerks. Since the system was inaugurated a few years ago the number of deposits annually has jumped from 3,000,000 to 15,000,000, the number of depositors from 2,000,000 to 9,000,000. In other words, on every business day 40,000 persons make deposits through 14,000 government substations. No wonder that, since the postal savings banks were established in England, nearly 500 private institutions of the kind have been forced out of business.

ICE-BOUND CAR FERRY BURNS.

Surrounded by miles of ice-bound waters, through which for several winters past she had been wont to force a way by means of a powerful ice-crusher, "Shenango No. 1," a large car ferry, 300 feet long, with a 54-foot beam, a height from keel to deck of about 60 feet and equipped with five engines, became the victim of flames and was utterly destroyed. The boat plied the 60 miles of Lake Erie's expanse between the harbor of Conneaut, Ohio, and Canadian ports, winter and summer, until the past winter when the 3,500 horsepower ice-crusher could not cope with the enthralled waters and she was laid up just off Conneaut, Ohio, where this spring she met the fate mentioned.

Burning of the "Shenango No. 1," a Lake Erie Car Ferry.

This season two ferries will operate across the lake. One between Conneaut, Ohio, and Port Stanley carrying miscellaneous cargoes, and another between Conneaut and Rondeau.

Peat, The Fuel of The Future

Methods of Drying Perfected and Humanity is Destined to Become Independent of the Coal Trust

Two million eight hundred and thirty-one thousand unprofitable acres; one-seventh of the entire area of an impoverished country; serving no purpose but that of a single element in an eerie landscape over which the weird voices of many winds have moaned and soughed for thousands of years; a brooding silence broken only by the terrified cry of some animal, or of a human, as it is swallowed, engulfed to a fearful death, in the treacherous, oozing depths on which it has ventured too far. Waiting for ages and ages; waiting the development of human understanding—a culmination of man's ingenuity. Ireland's emancipation waiting at Ireland's door to be accepted.

Peat Moor Near Drumfries, Scotland, Where the Peat Industries are Being Developed

Sodden huts, too close to the shelter of domestic animals for thorough sanitation; half-clad children with bare, red feet. Food? No food, oftimes. A crude turf fire, a bed of straw, a broken chair, a pipe and a crucifix. Hopeless mutterings; the keening of mourners and the wail of the new born. A proud ship in the harbor and a disconsolate little band leaving the "old country" because she refuses her children sustenance.

Behold the transformation!

Two million eight hundred and thirty-one thousand profitable acres! Great plants installed upon the bogs, to which are trudging thousands of hopeful, happy sons of Erin. The joyful sounds of labor. Great electrically-driven excavators taking the peat from its bed, reducing it to small particles and spreading it out to dry; other machines to gather up the half-dried peat and yet others to press it into form, when it is ready to be sent out all over the world; ready, too, to burn on Irish hearths and to brighten Irish homes with the revenue it has brought. The life—the activity of a thousand and one interests, newly-awakened!

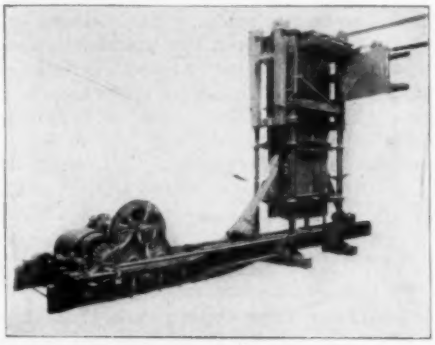
This is what the peat fuel industry is to do for Ireland. What it may mean to other countries can never be as much, although it amount to the same in dollars and cents. When we consider that Sweden prepares and uses 2,000,000 tons of peat briquettes annually; that Germany's peat supply is greater than her coal resource; that England, Scotland and Wales have a combined bog area of about 6,000,000 acres; that Russia produces 4,000,000 tons of the prepared fuel annually from about 2,144,000 acres of bog; that Canada's vast tracts are as yet unestimated; that in Alaska, where want of fuel has meant death to many, the supply is unlimited; that France has about 6,000,000,000 tons of crude peat; that the United States is almost as well supplied and that within 50 miles of Chicago there is enough peat to supply that city with fuel for 100 years, then does the future's promise begin to assume monstrous proportions and men begin to wonder and to speculate.

Peat, it is claimed, is coal in the process of formation. What now are peat bogs, will be, in centuries to come, vast coal beds, buried deep in the earth and only reached, even by the best of methods, after much hard labor. Coal, however, is carbonized wood, while peat has its origin in mosses and aquatic plants. Where these mosses and plants are in the more advanced stages of decomposition the peat is black, and where they are less decomposed, it is brown. It is a spongy substance, containing 80 per cent water, and of a consistency ranging from that of a bran paste to that of clay in the bank. It is permeated with fibres, or tubes, which absorb and hold water. This is the reason that process after process for drying peat has been tried and, almost without exception, has resulted in failure. Every principle applicable to the conditions has been tried; hydraulic pressure, centrifugal force, filtration, etc. None were effectual. When the eager inventor thought to force the water from the crude material by compressing it, the tough fibres and tubes expelled the water they contained but did not themselves crush or break. When the pressure was removed they took up what water remained in the peat, expanded, swelled to bursting, exploded and broke the blocks of half dried fuel. Thus was the inventor's object defeated. Finally, those experimenting with peat, realized that the only way was to pulverize the peat until its fibres were broken into small particles. But even when this point was gained, preparing peat after the old laborious methods was too tedious and too expensive to give it commercial value. Draining the bog by means of trenches, paring off its surface with spades, and cutting the peat out in oblong pieces, putting it out to dry, "turning" it, "footing," "stooking" and "stacking" it, this was the work that took a long while and must be done by hand labor. A great deal of money had been expended in making experiments and establishing plants, when Mr. Alexander Dobson, of Beaverton, Ontario, put into execution the first process that made peat fuel of commercial value. Like others, he had experienced many difficulties, but persistency and faith in peat as the coming fuel were finally rewarded by success. The

Showing Drying Racks and Peat Drying Plant in Canada

Machine for Making Peat Dust which is Used for Packing, Disinfecting and Antiseptic Purposes. The Fibres are Woven into Antiseptic Bandages, Horse Rugs and Clothing. Machine Produces 15 to 20 Tons of Dust per Day and Five Tons of Fibre.

output of methods formerly employed for cutting peat from the bog was not great enough to keep a press running. This difficulty was overcome by the invention of an electrically-driven excavator and spreader. This machine digs the peat, pulverizes it and spreads it over the surface of the bed in broken particles. Sun and air do their part, evaporation of moisture on a fair summer's day being rapid, and when the electrical gatherer collects it, the moisture is reduced from about 85 per cent to as low as 35 per cent. From the gatherer it is dumped in a windrow beside the tramway, whence it is conveyed by an electric tram car to the factory and there disintegrated—ground so fine it can be handled by the press. Then it is conveyed to a rotary drier and the moisture is there reduced to about 10 per cent. The last process is that in which the peat passes through the press, coming out in the form of briquettes 2½ inches in diameter and 2⅛ inches thick. Very little at-



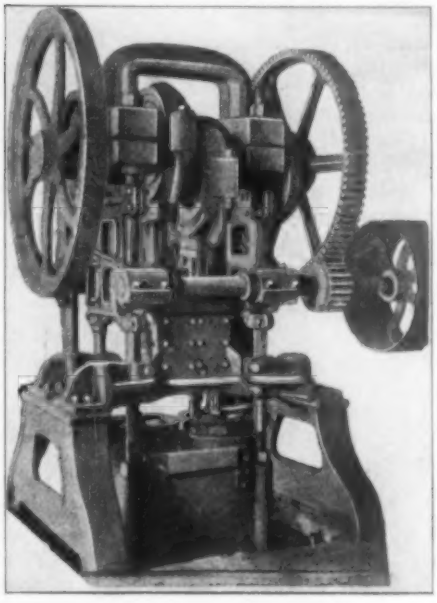
Peat Press of Messrs. Webster and Bickerton, of Goole, Scotland

tendance is required for this continuous process, the power plant requires the care of one man, and another keeps the machinery and fires of the rotary drier adjusted so that the moisture is kept at the proper percentage. The peat press is almost frictionless,—friction of the peat against the walls of the dies being prevented by oiling each die before recharging. Each briquette remains in its die six seconds and then follows the compression from another block being formed on top of it; six seconds later it is expelled and the second block succeeds it. Each machine is fitted with two punches having a die block containing eight dies. The base block against which the briquettes are formed is rigidly fixed, excess strain or pressure being counteracted by springs on which it

Peat Briquettes

rests. Two heavy eccentrics faced with roller bearings impart the down thrust of the punches, turning the die block through one-eighth of a revolution. In the die next to the compressing punch works the releasing punch which expels the finished briquette, and a third die receives an oil swab which oils the inside of the die with crude petroleum—helping to overcome friction in expelling the briquettes.

A 5-foot gear wheel operates the eccentric shaft, receiving its power through belting run to a pulley on the pinion shaft. Each shaft has a heavy fly-wheel for steadying the machine. Every minute 50 revolutions are made, the two punch systems acting reciprocally and the heavy briquette-forming pressure being exerted



Dobson Patent Peat Press

twice in each revolution, thus turning out 100 briquettes, weighing 40 pounds, per minute, or in other terms, a rate of one ton in 50 minutes.

This is the Dobson method, successful and practicable. Nevertheless, inventive genius has not stopped here. A recent method

Open Air Drying Racks at the Works of the Scotland Peat Industries

promises even more for the peat fuel industry. In this new process the peat is excavated from the bog by machinery and conveyed directly to the plant without the long delay of air drying. Here it is packed into rotary cylinders which are revolved at great speed, the peat being beaten by an interior beating device while the cylinders rotate. The centrifugal force expels the moisture so that it is a very low precentage. Then, by means of electrodes connected by conductors with a dynamo, the centrifugally-dried peat is included in an electric circuit; the resistance of the peat generates heat and it is carbonized. A mass of black globules represents the results and retains all the valuable properties of the raw material. It then passes to kneading machines and after being well kneaded it is either molded into briquettes, or left to dry and harden, in which latter case it is afterwards broken, screened and graded.

As has been stated, the value of this process lies greatly in the fact that in climates where the drying season is short it can be prepared despite the weather conditions. In Alaska a supply could hardly be prepared after other methods, and what a boon prepared peat fuel would be in that climate! It is a fact that the peat supply increases proportionately with the distance from the equator and, under the eternal law of compensation, there must be some means by which it can be utilized in those cold countries where it abounds. Again, in the electrical process, there is no loss, no escaping of valuable elements in the form of gases. One ton can be produced at the almost incredible cost of $1.21.

Prepared peat is an almost smokeless fuel. It burns to the last vestige, leaves a clean, white ash and no clinker.

Peat has been experimented with for many other purposes than fuel. A concern at Celbridge (near Dublin) on the Liffey, is manufacturing "ochre glazed" wrapping paper from it with success. Other uses are being inquired into. No life exists in peat, therefore it must be a good disinfectant. Peat moss litter is manufactured on a large scale in Scotland. Peat bricks, peat cement, peat fabrics, peat soap—all these are industrial items yet to be developed.

If, as is claimed, peat is incipient coal, the question may arise: Do we rob posterity when we consume both coal and coal in process of formation? Modern demands will never heed the question concerning so great a factor so easily obtained. But no matter! Peat one foot thick over one acre will make 300 tons of briquettes. There is enough to last until the millennium and then, probably posterity will not need it.

STEAM VESSEL TO CRUSH WAY TO NORTH POLE.

When Lieutenant Peary makes his next expedition to the North Pole, steam, instead of sails, will provide motive power. With this innovation it is expected that the "Charles H. Darling," a wooden-hulled vessel provided with powerful machinery, will be able to force a way through the ice.

Matthew Hansen, a colored man who has accompanied the explorer on all previous expeditions, will be with him on this trip, his qualities of bravery and good marksmanship placing him high in Lieutenant Peary's esteem.

The Zambezi river, at a point just below the magnificent Victoria Falls, is being spanned by a bridge 30 feet wide and carrying two railroad tracks. The bridge will be suspended 420 feet above the waters of the river.

Would you like to visit the St. Louis World's Fair? Earn the trip. Write to Popular Mechanics for particulars.

Future of the Submarine

Author of the Nautilus Says Its Use Will Be Confined to War and It Will Bring Peace

By Jules Verne

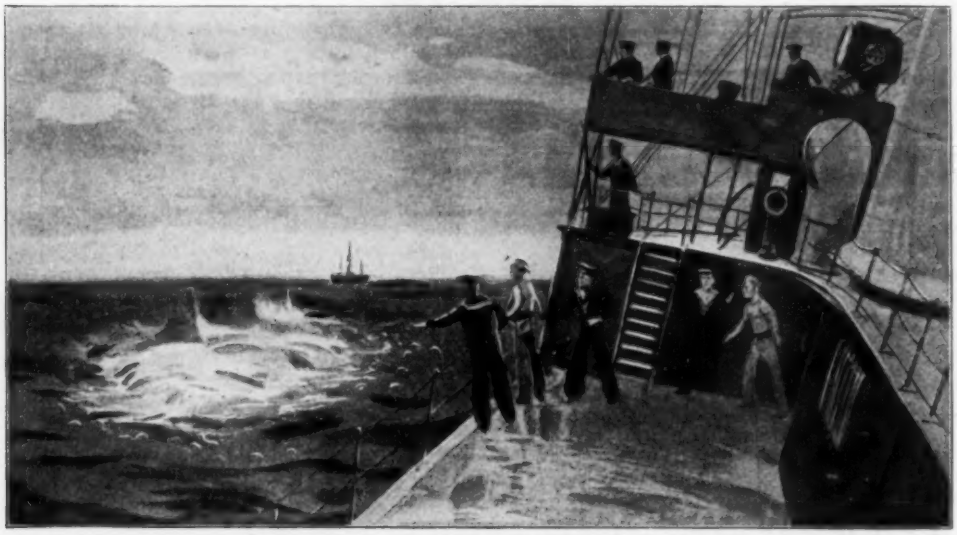
For some inexplicable reason many people insist upon regarding me as the inventor, or the imaginer, of the submarine. I am not in any way the inventor of submarine navigation, and reference to the authorities will show that many years—fully fifty, I should say, before I wrote about the Nautilus—the Italians were at work upon submarine war vessels, and other nations were busied with them, too. All that I did was to avail myself of the great privileges of the fiction writer, spring over every scientific difficulty with fancy's seven-leagued boots, and create on paper what other men were planning out in steel and other metals.

First Test of Submarines in a Gale.—Portsmouth Flotilla Navigating the Surface in a Wild Sea

The future of the submarine, as I regard it—and let me here disclaim all gift of prophecy—is to be wholly a war future. The Nautilus, as I have written of it, will never be, I think, an actual fact, and I do not believe that under-sea ships will be built in future years to carry traffic across the ocean's bed to America and to Australia. Even if the air difficulty were successfully encountered (and I have my grave doubts as to the possibility of that), what would be gained by any such sub-ocean traffic except freedom from sea-sickness? No submarine would ever cross the bed of the Atlantic faster than a ship upon the waves would traverse it, and surely freedom from that bugbear is not a sufficient incentive for the creation of a Cunard line beneath the sea.

I am an old man now, and working, as well as my deficient eyesight will allow me, upon my one hundred and second volume of boys' stories, and as I look back on the years which have passed since I first wrote the life-story of the Nautilus, and of its owner, I see no progress in the submarine which makes me hope for its use as a commercial medium. It has been wonderfully improved, I grant you—miraculously improved almost—but the improvements have all tended to one point—its efficacy as a war weapon; and that will be its one use in the future, I believe. I even think that in the distant future the submarine may be the cause of bringing battle to a stoppage

altogether, for fleets will become useless, and as other war material continues to improve, war will become impossible. As time goes on, each nation will acquire a large and very rapid fleet of submarines. Each little vessel (I am inclined to think that in the future they will be smaller than they are today, and manned by one or two men only) will be absolutely in control, and will be able with scientific accuracy to place torpedoes underneath the greatest vessels, and to blow those vessels up. I do not think that any apparatus will be found to counteract the intense rapidity and certainty of the submarine, and eventually, when every nation has its fleet of hundreds of these little vessels, what is to war with them? They may be able even to blow up huge tracts of country, and retreat unseen, some day; who knows?



The End of a Submarine—Air Bubbles Rising to the Surface Showed the Location of the "A 1" of England Which Sank with All on Board

Submarine Torpedo Boats Rising to Surface to Claim Theoretical Destruction of a Battleship

Of course, before these things can be, improvements in the submarine will have to be manifold, and almost as wonderfully ingenious as the beginnings of this greatest wonder of man's science; but these things will, I think, be possible.

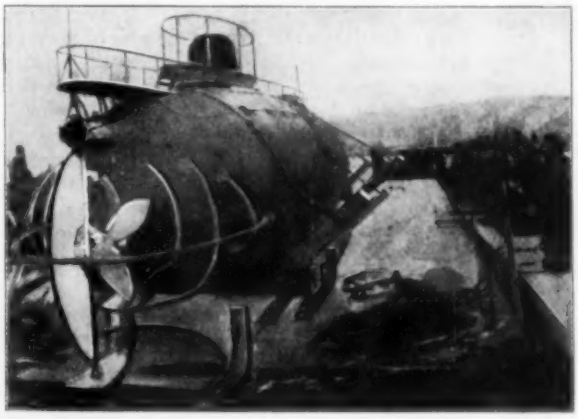
I followed very carefully the experiments made lately during the French maneuvers in the Mediterranean, and during the maneuvers of the English fleet, and I was very much struck by the accuracy with which the submarines of both fleets managed to slip in, strike, and get away in safety.

Imagine hundreds of these vessels with their deadly freight. Can you suggest that any means would counteract their deadly power? I do not think so. The refraction of the water, the depths to which the submarine can sink, its freedom from all observation—all these things make it the deadliest of war inventions, and in future years, when I myself am under ground, these powers will be enhanced. I do not think that

apparatus will be found to render them more harmless. The sea is hard to pierce, and I can think of nothing, even upon paper, which will enable men on board the superm're vessels to trace the tracks of their deadly little foes beneath the waves.

But as a commercial item in the world's civilization, I do not thing that submarines have any future. Air may be found for them, but even so it will never be found plentifully enough to make it possible for a large number of passengers to travel for a length of time in comfort. Electricity for their propulsion may, one day, be gathered from the sea itself, but I have doubts of it; and even if these things were done, the pressure of the sea at any depth would crush a submarine to fragments, unless some hitherto unheard-of metal were discovered which would withstand the pressure. Think of the size a trans-Atlantic submarine would have to be, and think how slowly it must travel, owing to the pressure of the waters round it, and tell me if you think a Majestic will ever be made to travel to New York upon the sea bottom.

I doubt it—doubt it very gravely; and, as I have said, I do not see that there is any need for submarine trans-ocean vessels. But submarine fleets are in the near future and they will, I believe, prove the thin end of the beneficent wedge which will cause war to cease between the nations, owing to their very deadliness. Unfortunately their work will not be done in my time. I am a man of peace and should have loved to see it, but it seems that my fading eyes are destined to behold sickening carnage in the unequal contest of the improved submarine machine with the heavy battleship, whose days are numbered.



Submarine Launched from an Ice Platform at Vladivostock

War Vessel With Nets Out—The Battleship's Only Protection Against Torpedoes.

LONG VOYAGE OF TORPEDO FLOTILLA.

Five torpedo boat destroyers, comprising the first torpedo flotilla of the United States navy, after a trip of over 18,000 miles, arrived at the Philippine Islands on April 1 in good condition. The torpedo flotilla went to join the Asiatic fleet, leaving Hampton Roads December 12 and arriving at the Islands April 14, a trip of 124 days, 54 of which were spent in port as the quarters on board the destroyers were cramped.

The trip clearly demonstrates the superiority and seaworthiness of these United States craft—the smallest perhaps that ever made such a voyage with so few incidents of moment. The little vessels are each 245 feet long, 420 tons displacement, 8,000 horsepower and have a maximum speed of 30 knots an hour. The service their crews render is of high grade, both in seamanship and accuracy of torpedo fire. The expedition was under command of Lieut. Lloyd Chandler, who has expressed himself confident that the boats can go to Hades and back.

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ELECTRICITY—WHAT IS IT?

By Jay G. Wait.

At the present time we understand a great deal about how to generate and control this subtle element or force—but as yet there has been no theory advanced to explain satisfactorily what it is.

The following theory may clear the matter up—or at least aid in doing so, and for this reason it is given:

A few days ago the papers reported that an inventor had discovered a method by which the music of the spheres or stars could be heard, and it was stated that a ray of light from Sirius or any of the fixed stars, striking upon a disk would make a musical tone which could be heard by the person using the inventor's machine, but that the rays of light from the sun produced jarring or discordant notes.

The point which arrested my attention in this is that it seems that a ray of light—a single ray—is separated out, and that it has force—for it strikes the disk, and makes a vibration producing musical tones. My theory is that the sun is an electrical sphere and not a solid or fluid mass of matter burning itself up, and that it takes as much from the universe as it gives, thus preserving a balance. The rays it sends out are positive electricity and as one motion must create another, the reverse motion is negative electric ether which, when it reaches the sun, is changed to positive, and sent out again. This electric sphere is so large that if its center were located at the earth's, its outer circumference would reach over 200,000 miles beyond the moon and in the other direction 400,000 miles, for its diameter is over 800,000 miles. It is so far away that it looks about the size of a large plate or half bushel, and its rays of electricity or light travel at the rate of 95,000,000 miles in five minutes. These rays of light are intensely hot, and striking upon the surface of the water at the equator, produce an evaporation which makes the atmosphere in which the earth circles and moves.

The rays of light from the sun striking our atmosphere are retarded—there is friction which creates electricity—and so the earth is surrounded by electricity which nourishes plant and all life.

When the earth has turned on its axis and the "sun is down"—we have darkness and less electricity, which no doubt induces or causes sleep.

Lord Kelvin photographed electricity—or rather its motion—which he found to be circular, or wheel-shaped. The definition of heat is not the absence of cold as it used to be, but it is said to be a mode of motion. In the liberaion of the gases in coal, motion is produced which we sense as heat. Other modes of motion we sense as sound and light.

Now it is very evident that when we telephone to a friend hundreds of miles away—that the vibrations are not carried through the wire, but that the batteries draw around the wire electric ether, which carries the vibrations thousands of miles per second, and we find that the wireless messages go through the air much more freely when sent from elevated towers or poles, than in the denser medium close to the earth.

The earth is surrounded by electricity, both positive and negative, which is sent here by the electric center—the sun—and in a few years we will know how to utilize the rays of the sun to generate this element so that its cost will be but nominal.

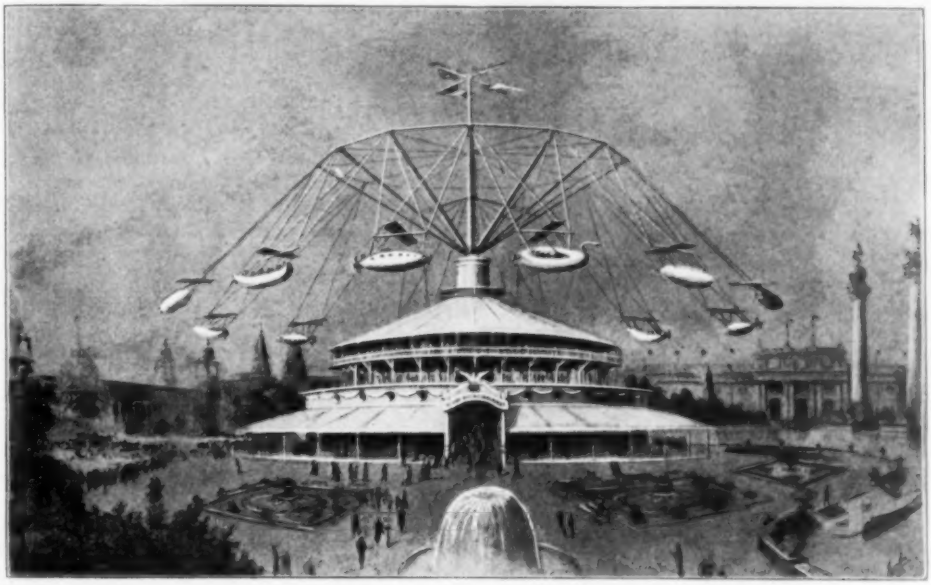
If heat is a mode of motion generated by atoms of matter changing place and form, electricity must be the same, for heat, light and electricity are very similar, and so we may say that it is etheric matter in a high-grade cassiterite.

The Chicago patent association is urging legislation appealing the present court practice of refusing injunctions asked against the infringement of patents on the ground that the validity of the patent had not been previously established by the courts. This practice, it is declared, cuts at least eight years from the life of every patent granted.

Newest Sports of the Thrilling Kind

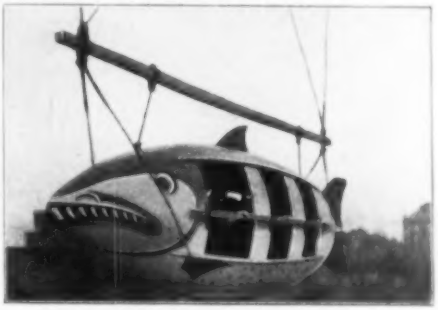
Sir Hiram Maxim's Revolving Umbrella and a New Loop the Loop Will Please the Lovers of Poignant Physical Sensations

How would you like to be spun around, at the speed of 60 miles an hour, in a car hanging to the rib of a giant umbrella which is 200 feet in diameter? That is the amusement of the future and its thrills you may soon experience for it is coming to America. The device is called the "umbrella flying machine," and is the invention of the noted Sir Hiram Maxim of aeronautical fame. The "umbrella" made its appearance a short time ago at West Norwood, England, and is soon to be seen at the Earl's Court and at the Crystal Palace, London. It is a roundabout in which the revolving bodies are suspended. High in air and hanging round the rim by steel wire ropes are cars, quaintly shaped and painted like fish. The cars generally hold four people each. They are boarded by the passengers from a platform encircling the outer central pavillion, when the "umbrella" is "closed." At this time the umbrella is 66 feet in diameter and 200 feet in circumference. As soon as the cars are all occupied the signal is given and the umbrella begins to open and circle around at the same time. Faster and faster it goes and wider and wider the umbrella opens and the cars fly out farther and farther until, instead of describing a circle 66 feet in diameter and 200 feet in circumference, they are speeding round a circle 200 feet in diameter and more than 600 feet in circumference.

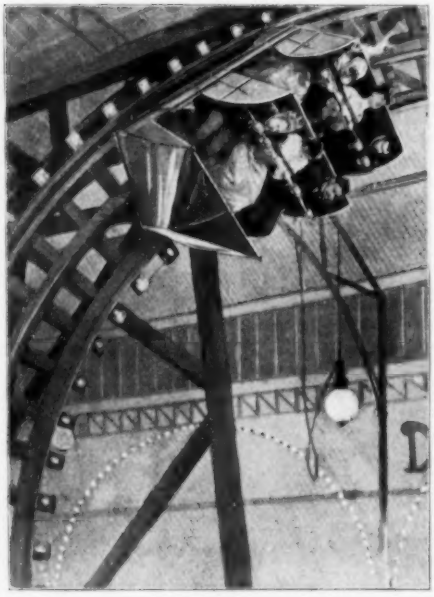


Sir Hiram Maxim's Revolving Umbrella

Below the platform by which the people mount the cars is a powerful engine which furnishes the power for rotating the "umbrella." This device probably is destined to supersede the "loop the loop," the "shoot the chutes," the "Ferris wheel," and other such thrilling amusements so popular in American cities.



Car of the "Umbrella"



Looping the Loop in Paris

But there is a new method of "looping-the-loop" which has appeared in Paris and Chicago, that may add still more zest to that exciting feat. The looping apparatus shown in the picture is now located at the Pole Nord, Rue de Clichy, Paris, and at Sans Souci Park, Chicago. It differs from the former "loops" only in that the loop is larger and the cars go faster. They are provided with an angular wind shield in front to lessen the friction as much as possible while the car is making its rapid turn and while the occupants are riding with their heads down. The apparatus is about 166 feet in total length. The platform upon which the track is fixed is 33 feet wide and its extension is nearly 290 feet. The point of departure is raised 48 feet above the point of course, while at the terminal it is raised 26 feet. The loop itself is formed as is usual of a spiral helix, the height of which is 36 feet and the diameter 26 feet. The light little car which tears along the track has two seats and can hold six passengers. The loopers are taken up to the platform by an electric elevator. As soon as they are securely seated the car is given a light push and it at once starts off, negotiating a plane inclined to 45 degrees. In four seconds, during which 83 feet have been traversed, a speed of nearly 40 miles is reached. Centrifugal force is the power that holds the car on its tracks.

SCALE TESTING CAR.

A car for testing scales is being used on the Illinois Central R. R. The car is of steel construction and is loaded with 50-pound United States standard test weights to the amount of 20,000 pounds, the gross weight of the car being 61,000 pounds. When run upon the scales, if a weight greater or less than 61,000 pounds is shown, the scales are not accurate. Track scales are tested twice a year and all other scales at least once a year. The Railway and Engineering Review says the work costs the company about $600 per year, but is well worth its cost of maintenance.

MECHANICS FOR YOUNG AMERICA

Things a Boy Can Make Out of Old Bicycle Parts

There are many things a boy can make out of parts of old bicycles, which he can either sell at a good profit, or can use for his own pleasure. Second-hand bicycles can be purchased for $3.00 or $4.00 and the ingenious boy can realize twice as much more on them.

A hat rack may be fitted up like Fig. 1. This involves, first the employment of three parts of tubes, about 10 inches long, soldered into a disk as at B, fitting the main part A. This main part is simply the cycle handle bar and steering shaft. The stand is coated with black varnish and the bars and shaft polished. The stand will sell for $1.50.

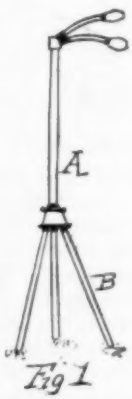


Fig 1

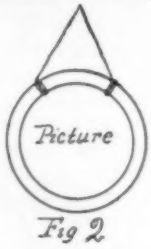


Fig 2

Fig 3

Rip the tires off the wheels and stuff them with curled hair and then clean and furnish them with wire supporting arrangements as represented in Fig. 2. Fit a disk of tin into the circle for a back. The two tires may be sold for 75 cents each for picture frames. The seat may be utilized as in Fig. 3 and a little hall or nursery stool results. The saddle with bar is simply set into the union of four pieces of tubing, each tubing being about 10 inches high. The connecting part is at C, which is adjustable, so that the height of the saddle can be regulated. These sell for $1.00 each. The frame brings another dollar when merely cleaned and repainted and fitted with a little wire to hold it upon the wall, with some sort of an inscription, on a walnut or sheetmetal background as shown.

Every part of the frame may be used in some way. Fig. 5 is a cluster of tool handles and parts made from tubes and joints. D shows a part provided with plug in the tee and into this plug is driven the

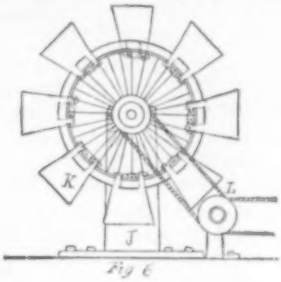


Fig 6

Fig 4

head of the punching tool required, this framing an awl or similar tool. E is a straight tube into which a hardwood mandrel is driven and there is a furrow on this mandrel and a shaft is inserted for screw driver or chisel. F is a little tube carrier, made with two sections of tube, one fitting within the other and either end closed with soldered disks. This is for holding tacks,

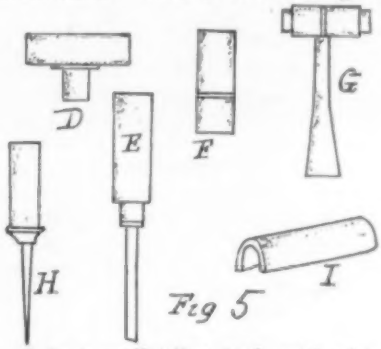


Fig 5

etc. G is a mallet-like tool, with the tube portion sustaining the wood or lead plugs for "soft" work. H is a prick tool made

of handle tubing, and the tubing is fitted with a flange and solidified with babbitt metal run in, or with hardwood plug. I is a half tube, used for miscellaneous purposes about a shop. By the use of these various parts of wheels boys can derive about $14 for each wheel, costing originally three or four dollars.

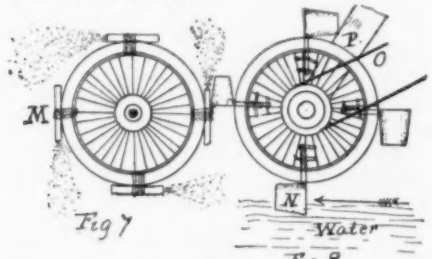


Fig 7 Fig 8

One of the richest fields is the use of the wheels of bicycles for mechanical devices. Fig. 6 is a windmill affair made with tin wings, the feet of which are split as shown, and one side of the tin is placed on one side of the tire and rim and the other on the other, and the two bolted on the inner side. The wheel is placed in a shaft bearing so as to revolve on a stand J. The wheel wing is marked K. At L is a wheel which is of wood and is grooved and arranged to guide the rope belt from the similarly grooved wheel on the driving wheel to the wheel L and onward to the mechanism to be driven. The wind plays against the wheel wings and the wheel is revolved.

A fireworks wheel is shown in Fig. 7, consisting of taking the wheel complete as in the windmill case and fitting the fireworks

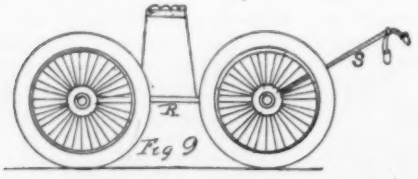
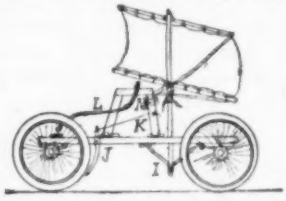


Fig 9

cylinders M by wires. These rockets or fuses, when lighted, cause the wheel to revolve as a pin-wheel is turned, and the display is quite effective. A model of a cycle wheel is fitted up as in Fig. 8, with the wheel arranged to turn on its bearings, the latter fitting into a wood projection P. This projection allows the wheel dippers to reach the flow of water. The dippers are ordinary kinds, and are wired to the spokes as shown. The flow of water forces itself against the dipper as at N turning the wheel. A pulley which is grooved is fitted to the shaft to drive the belt O, and this belt runs to the device to be operated. Vehicles for freightage purposes form a part of the cycle part construction shop trade. Fig. 9 illustrates one of the altered contrivances. Four wheels are selected and axles adjusted and a body placed thereupon, marked R. On this body, which is of wood, is the box seat. The handle bars and shaft are arranged to join on to the fore axle as at S, and this is the means by which the affair is hauled.

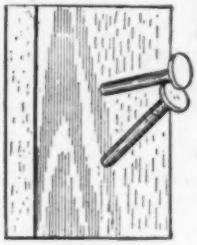
HOW TO MAKE A WIND PROPELLER.

A wind propeller may be constructed with four old bicycle wheels arranged with shafts pretty much like the shafts of a hand-propelled cart. The platform is flatter, however, and the body one tier so that it is lower. A framework of wood is built at M and this is a support for several purposes. The sail is secured to the mast which is fixed into the body of the cart as shown. The sail is linen fabric. There are two crosspieces to aid in keeping the sail properly opened. The steering arrangement is



through the rear shaft. The shaft is pivoted as in a hand-propelled cart, and the rod I extends from the middle connection of the shaft up to a point where the person seated on the wooden frame can handle it. There is a brake arranged by making a looped piece J and hinging it as shown. This piece is metal, fitted with a leather face. The cord K is pulled to press the brake. I marks the support for the mast underneath the body of the cart. In a steady breeze this cart spins nicely along the roads.

TO HANG HEAVY THINGS ON A NAIL.



Boys will find many places around the house, where a hook to hang things on will be a great convenience. Instead of buying hooks use wire nails, and if driven as shown in the cut, they will support very heavy weights. Drive the lower nail first.

THE NATIVE VEHICLE OF JAPAN.

Tokio Society Rides in a "Jinricksha," Drawn by a Man Instead of a Horse

War has not checked all the pleasure pursuits and gaiety of Japan. A favorite amusement of the wealthy young women

Human Horses in Japan

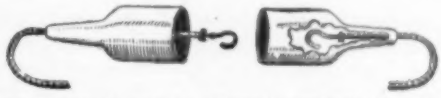
of Tokio is riding in their native two-wheeled vehicle pulled by a Japanese instead of a horse. The motive power in this contrivance is known in Japan as a Jinricksha-Man, and the vehicle is called a Jinricksha. These pleasures are not the Japanese woman's after she marries, however. Americans would call the Japanese Mormons, for each of them has many wives and after the Japanese girl marries she is allowed few privileges. She is made to blacken her teeth, pull out her eyebrows and make herself as ugly as possible so that no other man will be attracted by her. The women shown in the Jinricksha are not married.

AUTOBOATS BECOMING POPULAR.

Autoboats are attracting the attention of automobile devotees to an extent which threatens to make the autoboat the more popular of the two. Many prominent persons attended the recent autoboat races at Monte Carlo, where the enthusiasm over the autoboat is great. To maintain great speed, motors of a high power have been used on little boats, this practice is dangerous, however. The autoboat is destined to be popular with a large class who care nothing for automobiles, but delight in water sports.

SHIELDED FLEXIBLE CONTACT FOR USE IN CAR HOUSES.

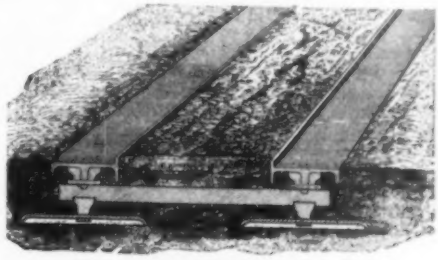
A flexible overhead contact for use in car houses where the cars are moved by means of their motors is described by the Street Railway Review. A loose, flexible contact is attached to an over-running trolley carried on an overhead conductor. The end of the connection is bare and hook-



shaped so it can be placed against the bare shoe support. Over the hooked end is a wooden cylindrical shield which covers the bare wire when not in use and can be moved back to leave the contact free for use. This protects the workmen from accident by coming in contact with the bare wire.

STEEL TRACK HIGHWAYS.

There are those who believe the time will come when hundreds of thousands of miles of our country highways will be laid with steel track for the use of wagons and carriages. When that time does come, we may safely predict the wagons will not be drawn by horses and mules to any great extent—they will be motor wagons. The illustration herewith is interesting, however, as having demonstrated the great advantage of hauling over steel rails, or plates, instead of on the best macadam road. On the steel



Steel Track Highway

track roadway one horse in a light harness was able to draw with ease a load of 11 tons, which same load on a common road required 20 horses to pull.

The expense per mile of building such a road as illustrated is as follows: rails and accessories, $4,000; digging trench and laying track, $600; broken stone, labor, rolling same, $1,100; total, $5,700.

Lathe Attachments

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GEAR WHEELS AND ROTARY CUTTERS.

In taking up the subject of Gearing it is not the intention to go into the theoretical part, but to show a simple method whereby the amateur may be enabled to calculate and make the gears for use in his models, etc.

In practice gears are cut on special and complicated machines made for that purpose only and there are many different kinds of gears, but only such as may be cut on a small lathe, with apparatus heretofore described, will be referred to.

Gearing is a means of transmitting motion in machinery by the use of toothed wheels. Frictional gears have no teeth, the one gear, to which rotary motion is imparted, driving the other by means of friction alone. This would be a very convenient means of gearing, if there were no slip to contend with, and is often used for special purposes, but, where a positive motion is necessary, teeth are added working one within the other. These teeth are so designed that the proper clearance may be had at each moment of rotation, otherwise they would bind and stop the machinery or break.

There is a line existing geometrically in all gears called the pitch circle, or pitch line, which is the circumference of the cylinders or blanks without teeth and is, in practice, a little less than one-half the depth of the tooth. The distance measured along this line of a tooth and a space, or from the center of one tooth to the center of the next tooth, is called the circular pitch. In calculating gears it is necessary to know certain fixed proportions which are given herewith in both common and decimal fractions:

Thickness of tooth equals 12-25, or .48, of the circular pitch.

Width of space equals 13-25, or .52, of the circular pitch.

Height of tooth equals 7-10, or .7, of the circular pitch.

Height of tooth above pitch line equals 3-10, or .3, of the circular pitch.

Depth of tooth below pitch line equals 2-5, or .4, of the circular pitch.

In small wheels the width of tooth equals twice the circular pitch.

We will only consider one form of tooth which is called the single curve or involute system, and is adopted on account of ease of setting out and cutting, and general efficiency. Let us now proceed to set out a gear having this form of teeth.

We will select one of forty teeth, ½ inch, circular pitch on account of ease in explaining the method. We first find the diameter of pitch circle by multiplying the pitch by the number of teeth and multiplying their product by .3183. That is, ½ inch times 40 equals 20 inches and 20 inches times .3183 equals 6.366 inches which is approximately 6⅜ inches.

With a pair of compasses describe a circle (X) of this diameter. Using the dividers, point off this circle into parts equalling one-half the pitch which is, in this case, ¼ inch. Next, draw a line (A — a), Fig. 1 from the center to one of the points on the pitch circle. With a radius equal to one-half the length of this line erect a semi-circle (C) with point (B) as a center. Now draw circles representing the depth of teeth (Y) and the height of teeth (Z) according to the table. That is, the circle (Y) will be 2/5 of the circular pitch below the pitch circle (X) and the circle (Z) 3/10 of the circular pitch above. With a radius, equal to one-fourth of the diameter of the semi-circle (C) and the point where pitch circle

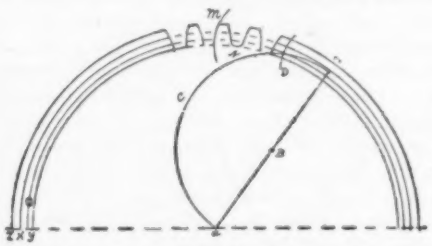


Fig. 1.

(X), radius (A—a) and semi-circle (C) meet, draw an arc (D) through semi-circle (C). With (a) as a center and a radius equal to distance from (a) to point (D) describe circle (O), which is called the base circle. The centers for arcs forming sides of teeth lie on this circle. The diameter of the circle (O) or base circle is .97 of the diameter of the pitch circle. Now, set the compasses again to a radius equal to one-fourth the diameter of the semi-circle (C) and, letting one leg pass through the points made in dividing the pitch circle and the other leg resting on base circle, draw arcs forming sides of teeth as at M. The bottoms of spaces can now be rounded off by hand as at N.

If the fore-going instructions be carefully

followed there should be no trouble in setting out any spur gear on paper.

To cut a gear from the blank the first thing to do is to lay out the gear on paper. Next make a templet of thin brass or zinc, cutting out to the exact form of space between two teeth. This is for shaping the cutting edge of rotary cutter. To make the cutter, mount a round piece of steel previously softened, on a mandrel in the lathe. Turn up the edge to exact form of templet. Remove from mandrel and file teeth in cutting edge, or teeth may be milled in, using the division plate and milling attachment. Heat to a cherry red and plunge in cold water. Heat a flat piece of iron to a white heat and hold the cutter over it until it is

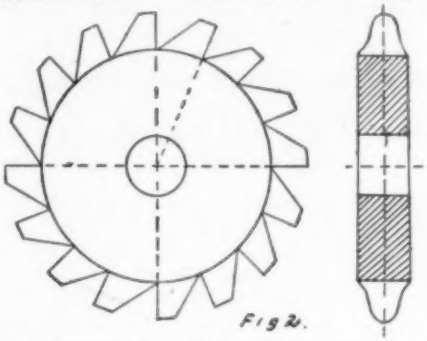


Fig 2.

of a straw color after which cool out in water. The art of tempering is only learned by long practice but once learned is never forgotten. Having finished the cutter, mount it in the milling attachment and mount the gear blank on a mandrel between lathe centers and, using the division plate to space the teeth, mill them out as previously instructed.

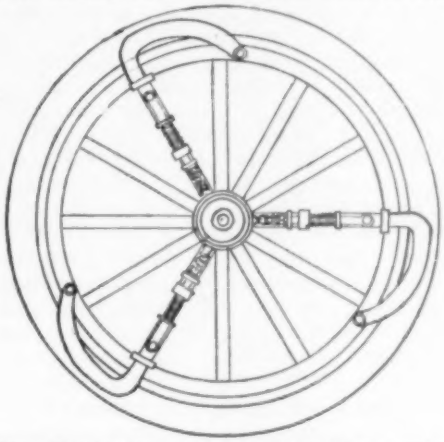
A form of cutter is shown in Fig. 2 and needs no further explanation. Cutters can be made from old flat files by softening them and cutting roughly to form with a hack saw or file and finishing in the lathe.

TROLLEY CAUSES APPENDICITIS.

The trolley car, in that it causes us to walk less than we used to, is the cause of the alarming increase in appendicitis, declares Dr. Thomas W. Lauterbon of New York. He says that when the abdominal and intestinal muscles are kept continually active by walking, the entrance to the appendix is always closed and there is no danger of appendicitis. That there is something in his theory seems true, since appendicitis does not flourish in the country as it does in the city.

SIDE-SLIP PREVENTER FOR AUTOS.

A Dublin, Ireland, inventor has devised an appliance which prevents an automobile from sliding out of its course when swing-



The Nicholson Side-Slip Preventer

ing around a corner at high speed. The Motor News, Dublin, says: "There are three grippers, made of sheet steel, and they work on a stud fitted on to a ring, concentric with the rim of the wheel. When in action the edges of these grippers are level with the tread of the tire, and consequently just touch the ground as the wheel revolves, with the result that side-slip is checked in its inception by the edge of the gripper coming in firm contact with the ground. The gripper is so designed as to roll into action, and it is fixed quite clear of the tire, which is consequently unaffected. In the drawing the gripper is shown out of action. That the contrivance is effective as a non-slipper we can state definitely from personal experience."

The mechanism is worked by means of a hand lever.

METAL RESEMBLES SILVER.

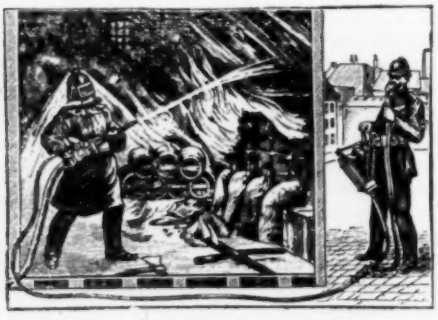
Aluminum silver, or "silver metal" composed of copper 57 parts; nickel, 20 parts; zinc, 20 parts; and aluminum 3 parts, is an alloy coming into use by typewriter companies for the spacing lever. It is nickel-plated when the machine is new, but as the nickeling wears off it still remains of a silver white color which will not tarnish or rust. This metal is conceded to be better than either brass, steel or iron for this purpose. It is stiff and strong, does not cost more than brass and will take on a high polish because of its hardness.

HOW TO WRITE ON PHOTO NEGATIVES.

It is very often desired to inscribe a title upon the negative of a picture so it can be printed at the same time. Copyright inscriptions are especially necessary to be handled in this way. The Photo Beacon gives an easy method as follows: Lay the negative on a piece of white paper, glass side up, and place a drop of retouching fluid where you wish to write the title. Rub it into position with the finger, let it dry for a few moments and then with a medium soft pencil write your title. Since the writing is on the glass side, it does not need to be reversed. You may take a rubber stamp and print in the ordinary way, as the medium will hold the ink. Of course, the whole thing may be rubbed off by using a little turpentine.

SMOKE HELMETS FOR FIREMEN.

Smoke helmets for city firemen are generally used in Germany. A fireman wearing one of these strange looking head gears much resembles a diver, especially as the comparison is carried out to the tube corresponding to the diver's air pipe. The helmets are made of stiff leather, with windows for the eyes, and a tight fitting collar. The hose pipe enters the back of the helmet and fresh air is pumped constantly by a pair of hand bellows at the other end of the pipe, which also serves as a speaking tube. Conversation is readily carried on for distances up to 160 feet. A fireman thus equipped can work for hours in a smoke which would otherwise cause his death in a few minutes. The helmets have been the means of saving a number of lives and much property, and their success will doubtless induce their early adoption into America.



Fireman's Helmet

50-MILES-AN-HOUR BOAT PLANNED.

Shaped and Propelled to Skim Over Water Instead of Cutting Through

Foreign automobile manufacturers are now interesting themselves in fast boat building. A plan has matured, according to the London Times, for the building of a boat propelled through the water so fast and of a shape "so cleverly devised that instead of cutting through the water it will skim over it, thus reducing water friction to an absolute minimum." S. F. Edge, a noted English racing automobilist, is confident in his belief that the boat will attain a speed of 50 miles an hour, "but the astonishing pace of 35 miles an hour," he says, "may be regarded as a certainty."

HOTEL BOATS FOR THE MISSISSIPPI.

Revival of Old Time Magnificence in River Travel

Steamboat travel on the Mississippi is to be restored this year to its old time comfort and splendor. River palaces which for years have been used only as freighters are being overhauled and fitted up in the most luxurious manner. Consorts, without power, will be equipped as floating sleeping hotels, and will be towed by fast gliding boats.

The attractiveness of a river trip which before the war made the water route preferred to the steam cars, is to be eclipsed. The great fair at St. Louis is the cause, and it is expected thousands living far from the banks of the river will enjoy for the first time in their lives the beauty of water and scenery afforded by this great waterway.

The steamers will contain the kitchens and dining rooms, and accommodate a large number of sleepers, while the consorts will have only cabins and staterooms. An orchestra will play every afternoon and in the evening there will be dancing on the main deck. On arrival at St. Louis the boats will be the hotels of their guests, and each night at midnight the boats will steam 15 or 20 miles up or down the river to escape the smoke and noise of the city. With engines working just enough to hold the boat against the current, and with cool breezes wafting through the boat, the guests will enjoy a good night's rest.

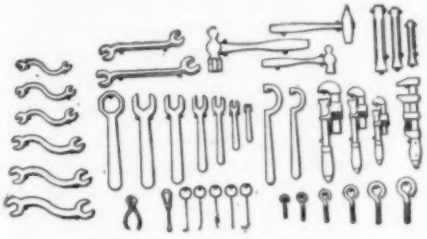
At daybreak the boats will tie up at their wharf near the fair grounds.

Send for Popular Mechanics premium list.

SHOP NOTES

TOOL RACK FOR ENGINE ROOMS.

Engine room tools, such as wrenches, hooks, etc., may be very conveniently arranged on a rack specially fitted for the purpose. Measure the space you can use for the purpose, being sure it is conveniently located. Lay out your tools, on a



Arrangement of Tools on Rack.

board of the proper dimensions, ranging them according to size and reversing the sizes where one row comes under another. Bore holes to fit the wrenches, and put screws for holding the tools in the places you have indicated on the board.

HOW TO WELD A STEAM DRILL.

To weld a steam drill say a 1¼-inch drill, split the steel both ways for about an inch, making four prongs. Turn them nearly straight and scarf the end of each prong to a sharp point. (See Fig. 1). Heat to a

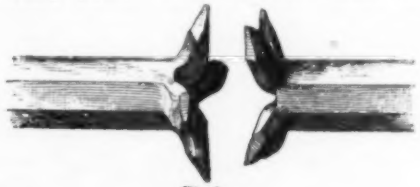


Fig. 1.

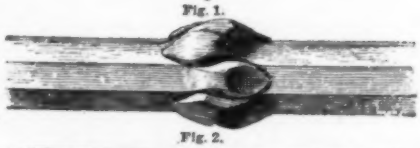


Fig. 2.

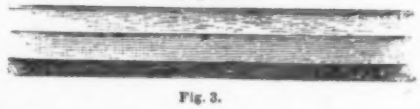


Fig. 3.

bright red, place together and hammer as in Fig. 2. They will hold closely. Place in the fire till in a white heat. By the help of an expert striker it can be welded with one heat as solid as in Fig. 3.

The correspondent, who describes this method in The Blacksmith and Wheelwright, says he has welded over a hundred drills the past year in this manner and never yet had a break.

HOW TO MAKE AN IRON BOOT FOR A CRIPPLE.

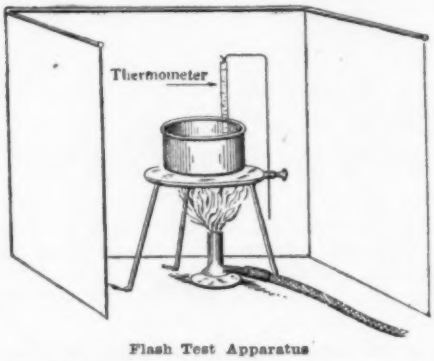
An iron boot for a cripple may be made by fitting a piece of old hand saw blade, the size of the heel and sole of the shoe, for the top, says a correspondent of the American Blacksmith. Take two pieces of tool steel (¼-inch) and bend them to the proper shape and rivet them to the sole piece. Fasten the iron boot to the shoe by means of small screws.

Boot for Cripple.

TO TEST LUBRICATING OILS.

A good test for lubricating oils is the flash test. Make a tripod of heavy wire and place it over an alcohol lamp or a Bunsen burner. Place a shallow enameled-ware drinking cup on the tripod, and from a wire support suspend a thermometer so that the bottom of the bulb will be about ½ or ⅝ inch from the bottom of the cup. The thermometer should register to about 600 or 700 degrees, and should be accurate. "A well-seasoned, gas-filled thermometer is best," says Power, "and will cost about $2.50 or $3.00." Around the instrument place a screen of sheet iron to protect it from drafts. Fill the cup to within one-eighth inch of the top, with the oil to be tested. Light the lamp and adjust the flame so the temperature will rise about 15 degrees per minute, not more. When at about 250 or 300 degrees Fahr., adjust it to about 10 degrees per minute. Have ready some pieces of hard-spun wrapping twine or some

toothpicks. If testing engine oil, light one of these pieces when the temperature approaches 300 degrees Fahr., and pass it across the surface of the oil. Repeat the operation from time to time as the temperature rises, until a faint puff of blue flame ensues. Note the temperature, which is the



Flash Test Apparatus

flash point. The burning point is the temperature at which the oil ignites of itself and continues to burn.

HOW TO MAKE A STEAM BLOWER.

In an emergency steam blowers may be used to provide draft for the combustion of coal in steam boilers. Fig. 2 shows a blower which was constructed for use with a battery of boilers of 125 horsepower to maintain a uniform steam pressure of 80 pounds during the cold winter months. "The blower was placed in the 48-inch circular uptake, the holes drilled so that the hollow jet would fill the uptake at about four feet from the jet," says a correspondent in Power. This increased the capacity 30 per cent, at a cost of 90 cents per hour, with coal at $3.90 per ton.

The jets give better service in round stacks than they do in square ones. Inserting a tube into a square stack, filling up the corners and placing the jet underneath is the most efficient method of using them with square stacks.

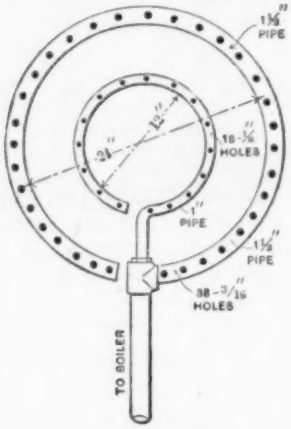


Fig. 2

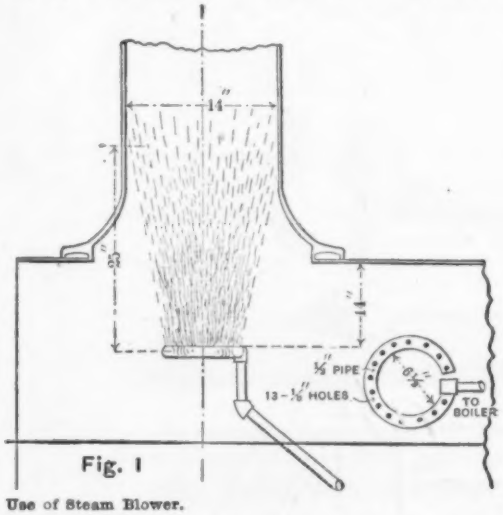


Fig. 1

Use of Steam Blower.

HOW TO STIFFEN A CROSS-CUT SAW.

One man can work a cross-cut saw by means of a simple contrivance for stiffening it. Make a strong, stiff bow, saw a slit in each end five or six inches long; take off one saw handle and insert a plug in one of

Stiffening a Cross-Cut Saw.

the holes in the saw. Slip one end of the bow over the saw in front of the plug and tie underneath with wire; bend the bow and slip the other end over the saw in front of the handle and tie as before. Have the teeth filed very beveling so as to bring as thin a cutting edge against the saw as possible, and do not file the rake teeth as short as you would if two men were working it. A correspondent of the Rural New-Yorker says you will be surprised how well it works.

PAINT FOR STEEL PLATES.

One of the large railroad companies uses the following recipe in making an excellent protection for exposed steel plates:

Four pounds pure lamp-black ground in raw linseed oil, seven-eighths gallon genuine asphaltic varnish, one-quarter gallon pure refined linseed oil, one-quarter gallon drying japan. One gallon of the paint will cover 350 square feet of surface.

HOW TO UNITE CAST IRON.

To unite ordinary cast iron is not an easy task, but it may be done, if one has luck, by boring a dozen holes in the parts to be united, then secure well and place about the break an abundance of filings of good pig iron, some wrought iron filings and also some of steel. Lute with fine clay and place in fire (before luting use any good flux, borax, etc.); heat until the filings melt and fill all the cavities. Let remain in the fire until fire goes out and the metal is cold; then remove and clean up.

TINNING CAST IRON.

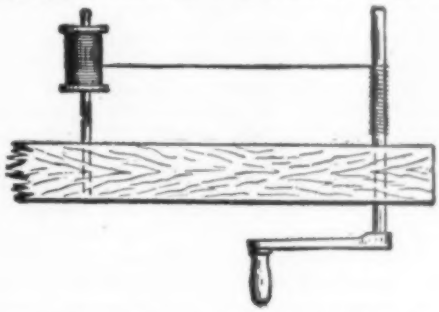
To be successful in coating with tin the castings must be absolutely clean and free from sand and oxide. They are usually freed from imbedded sand in a rattler or tumbling box, which also tends to close the surface grain and give the article a smooth metallic face. The articles are then placed in a hot pickle of one part of hydrocloric acid to four parts of water, in which they are allowed to remain from one to two hours, or until the recesses are free from scale and sand. Spots may be removed by a scraper or wire brush. The castings are then washed in hot water and kept in clean hot water until ready to dip. For a flux, dip in a mixture composed of four parts of a saturated solution of sal ammoniac in water and one part of hydrochloric acid, hot. Then dry the castings and dip them in the tin pot. The tin should be hot enough to quickly bring the castings to its own temperature when perfectly fluid, but not hot enough to quickly oxidize the surface of the tin. A sprinkling of pulverized sal ammoniac may be made on the surface of the tin, or a little tallow or palm oil may be used to clear the surface and make the tinned work come out clear. Some operators again dip in a pot of hot palm oil or tallow at a temperature above that of the melted tin, for the purpose of draining the excess of tin and imparting a smooth, bright surface to the castings. As soon as the tin on the castings has chilled or set, they should be washed in hot sal soda water and dried in sawdust.

TO DRILL CHILLED CAST IRON.

To drill chilled cast iron first draw the chill. This is done by laying the piece on the forge, covering the spot to be chilled with sulphur, and working the bellows slowly until the sulphur is burned off. Then proceed with the drilling.

HOW TO HARDEN BRASS AND MAKE SPRINGS.

Brass can be hardened by hammering or running through rollers while cold, says the American Blacksmith. To make a coiled spring, say a 5/16 spring, take a ¼-inch iron rod, put a crank on it or bend to shape of



crank and let it run out at one end. Bore a hub in a block of wood so the iron will fit tight, and run it through, fasten your wire on it and wind it on by turning the crank, having your spool post so you can hold it tight enough to stretch the wire.

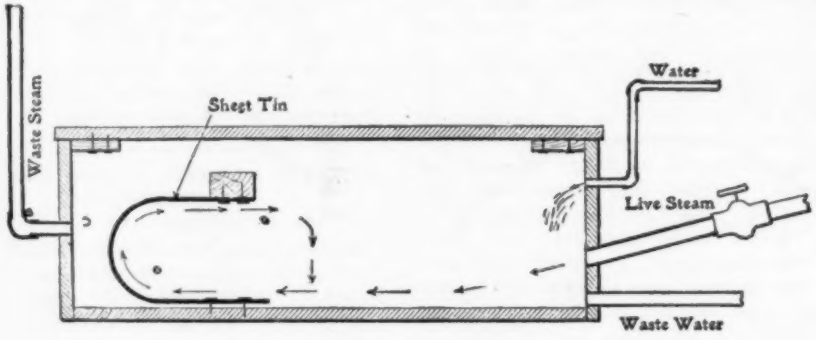
TO CLEAN CHASED BRASS.

Benares ware, or chased brass of any kind, may be cleaned thus: Wash well with hot water and soap and dry thoroughly; then rub all over with a lemon cut in half. When it looks quite clean, rinse well in warm water, dry and polish with a chamois leather. Chased work of any kind should not be cleaned with powder.

DEVICE FOR WASHING OVERALLS.

In the boiler house of the Union Steel Co., at Honora, Pa., the men have constructed a device for washing overalls, which will take the dirt and grease out of the worst possible specimen, and do it quickly. The sketch shows the machine.

The overalls are put in and the lid is closed, a fine stream of cold water is turned on, the live steam is started and they are then left to wash themselves. There must not be over an inch of water in the bottom.



FOR WASHING OVERALLS.

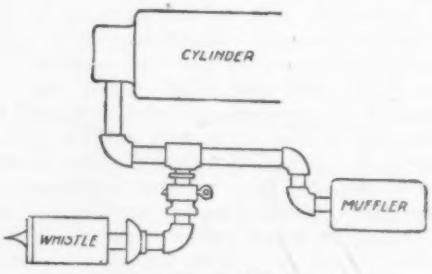
The live steam strikes the cloth and carries it in the direction of the arrows to the sheet tin. The cloth is compelled to follow the curve of the tin up and around. Then it drops in the stream of steam and water again, and so on. As it works in practice the cloth is passing around the tin continuously, being kneaded and turned in the hot water until it is perfectly clean. No soap was used, yet no doubt it would have shortened the time. An ordinarily dirty pair of overalls would be cleaned in two or three minutes. The box is about 4 feet long, 3 feet wide and 2 feet deep, but could perhaps be made smaller without harm. If too much water is used in the bottom, the steam tears the cloth instead of moving it.

WHISTLE FOR GAS ENGINE.

The most strenuous thing yet in the way of an alarm horn for automobiles has been discovered by S. W. Rushmore, of Jersey City. Beside it the shriek of the fire boat is like a child's whistle and the fog horn would be inaudible if they were blown simultaneously. Mr. Rushmore thus tells the Automobile Magazine how he came by the invention:

"I blew up the muffler of my Winton machine and noticed that a considerable increase of power accompanied the exhaust, and decided to see what gain there would be in cutting out the muffler of my 12-horsepower Packard. I placed a T in the exhaust pipe and to this connected a 1½-inch brass blow-off valve with lever connected to a foot button. I also coupled on an elbow so that the blast is directed backward and does not stir up a dust. Just as I got the thing finished I noticed in the shop a tug-boat whistle with a bell 5 inches diameter and 12 inches long, that exactly fitted on the pipe. I screwed it on, as per sketch herewith.

"When the relief valve was opened the whistle let out the most unearthly shrieks, showing that as the whistle was set for 100 pounds steam the initial pressure of the exhaust in the pipe leading to the muffler exceeded that amount. Each shriek was apparently of shorter duration than the length of a stroke and I thus argue that the excessive initial back pressure is not due to any defect in the muffler but to the inertia of the gas in the pipe leading to it.

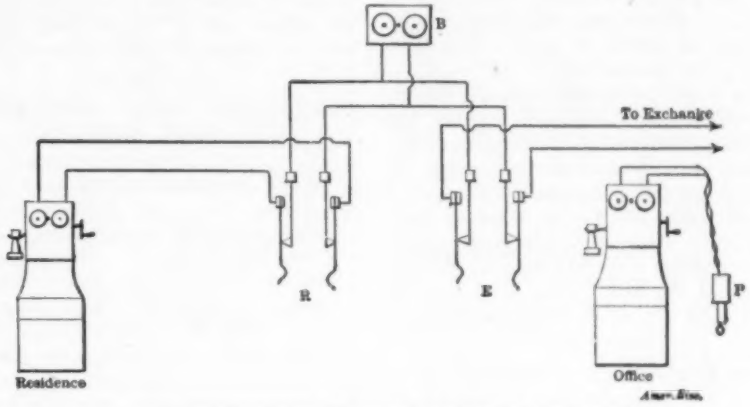


Connection of Whistle

"The thing is a great success in waking up truck farmers that I meet on the road, before they know what they are up against."

CONNECTING AN EXTRA TELEPHONE.

An arrangement whereby a telephone subscriber can connect his private office or residence on his office telephone, while subscribing for only a single instrument is given herewith: The office telephone set is connected to an ordinary two-wire plug, P, and two spring jacks, R and E, are provided, into either of which this plug may be inserted. With the plug inserted in the jack R, the residence instrument and the office instrument are connected together, leaving only the bridging bell, B, connected to the exchange circuit. With the plug inserted in the jack E, the office instrument is connected to the exchange wires, and the residence line terminates at the bridging bell, B. With the plug removed, as shown in the diagram, the residence instrument is connected straight through to the exchange.



CONNECTIONS FOR OFFICE AND RESIDENCE LINE.

The provision of the bridging bell, B, enables the exchange to call up the office when the office instrument is connected to the residence line, and also enables the residence to call up the office when the office instrument is connected to the exchange line. The plug would be withdrawn from the jacks, leaving the residence connected through to the exchange, only over night and during periods when the office is closed.

PREDICT WEATHER WITH CAMPHOR.

A piece of camphor gum is a very good indicator of what the weather is going to be. If, when the camphor is exposed to the air, the gum remains dry, the weather will be dry; if the gum absorbs moisture and is damp it is an indication of rain.

HOW TO MAKE A SPARKING COIL.

For a sparking or induction coil strong enough to ignite paper or cloth make a magnet core of a bundle of soft No. 20 iron wire, ¾ inch in diameter and 6 inches in length, wrapped in two thicknesses of strong paper laid with shellac varnish for insulation. Put thin wooden spool heads on the ends of the core wrappings, fastened with shellac varnish, says the Metal Worker.

Then wind the spool with four layers of No. 16 cotton-covered copper wire, with shellac varnish on each layer, passing the wire ends through holes in the spool head at the level of the last layer. Cover the coil with four thicknesses of wrapping paper well shellacked for insulation from the secondary current.

For the secondary coil, wind with 12 ounces of No. 34 double silk-covered copper wire, commencing by passing the wire through a hole in the spool head close to the paper winding of the primary coil. Cover each winding of the secondary coil with two thicknesses of wrapping paper, well shellacked to make the insulation perfect against short circuiting of the secondary current. Special care in closing each paper winding against the spool heads is very essential to prevent burning out. Dry the shellac varnish as the work proceeds.

With 10 medium sized dry batteries in series, a 1¼-inch spark may be obtained between wire terminals or a ½-inch hot spark between brass balls of ¾ inch in diameter. With eight Edison-Leclanche cells and a vibrating attachment, a brilliant spark effect may be had between the brass balls.

HINTS ON MELTING BRASS.

The following points were made by Chas. Vickers, of Chicago, in an address before the Boston meeting of the American Foundrymen's Association:

Compared with steel or iron it is an easy matter to melt brass. It is often melted on a small scale in an ordinary stove. Great waste of fuel occurs in using a 30-inch pot in a furnace intended for an 100-inch. Three inches of solid fuel should surround the pot, and will do the work of six or more. Tossing metal into the pot causes great waste by splashing. Be sure the molds are ready by the time the metal is ready to pour—costs money to "hold" a pot in furnace. Never allow your furnace to become barrel-shaped; straight sides are best. Gas in the shop is often caused by the furnace flues being too small; rather than the main flue. A fan in the main flue is good. When sheet iron is used for main flue it must be suspended and not allowed to touch the wall. Do not cover flues with asbestos to protect workmen from the heat; hang a curtain of asbestos, but do not let it touch the flue.

TO PICKLE BRASS CASTINGS.

The following method of pickling brass castings is recommended: If greasy, the castings should be cleaned by boiling in lye or potash. The first pickle is composed of nitric acid, one quart; water, six to eight quarts. After pickling in this mixture the castings should be washed in clear warm or hot water, and the following pickle be then used: Sulphuric acid, one quart; nitric acid, two quarts; muriatic acid, a few drops. The first pickle will remove the discolorations due to iron, if present. The muriatic acid of the second pickle will darken the color of the castings to an extent depending on the amount used.

HOW TO AVOID "SWEATY" PIPES.

The cause of so-called sweaty pipes is very simple and the remedy equally simple. Perhaps it is hardly necessary to explain that the pipes are not sweaty in the sense that the moisture comes through the pores from the inside, though this is a not uncommon belief among those who do not understand the cause. The moisture on the pipe is, of course, caused by the condensation of the moisture in the air, the difference in temperature between the air and the pipe causing the condensation of the natural moisture in the air and depositing it on the pipes. The difference in temperature between the air and the pipe is caused by the water flowing through the pipes. Water at rest in the pipes soon takes nearly the same temperature as the room. Even an occasional flow of water through the pipes will not cool them sufficiently to make them sweat, but even a slight constant dropping will cause the trouble. That being the case, it is only necessary to make tight all faucets and cocks on supply and flush pipes in order to put a stop to the trouble. Packing the pipes will of course help matters, but this is expensive and unnecessary.

CONNECTING PIPES WITH RIGHT AND LEFT COUPLING.

"While speaking of piping I thought of something today that I might have thought of years ago with profit," says a correspondent of The Engineer. "In connecting two pipes with a right and left coupling try the coupling on each pipe, and count the number of turns necessary to screw it on each one by hand. You generally find that the left-hand one will require two turns more than the right-hand. This is because the left-hand dies are not used as much as the right-hand, and consequently they cut a smaller thread.

"In order to have both ends of the coupling make up the same, the end of the coupling that screws on the pipe farthest should be started first and given as many turns as is necessary to equal the difference between the number of threads employed at each end. This should be done before starting it on the end of the other pipe. For instance, if the coupling covers 12 of the left-hand threads and only nine of the right-hand threads at the opposite end, then the end having the left-hand threads should be started first and be given three turns before starting the end having the right-hand threads. This will enable the coupling to be screwed up tight on both pipes at the same time."

CEMENT FOR PIPE JOINTS.

At a meeting of the Ohio Gas Light Association in Columbus, Mr. George Light recommended a cement for pipe joints, consisting of a mixture of ordinary pine tar and dry oxide of iron. This cement, Mr. Light stated, is as good in a faced or rough

flange joint as red-lead putty, costs about one-tenth as much, does not harden as quickly as red lead, and is very adhesive under pressure.

HOW TO USE CEMENT IN COLD WEATHER.

In cold climates the employment of concrete has its objections, in that the material will freeze before it sets, and upon thawing is found to be practically worthless. In such cases the operation of setting may be hastened by dissolving two pounds of carbonate (not bicarbonate or cooking) soda in one gallon of water, boil the solution and use it in mixing the concrete with whatever additional water is required; the water and sand should also be heated. This heat will remain long enough to allow the concrete to set, which should be about 45 minutes. Subsequent freezing, if the mass is not thereby cracked, will not injure the concrete.

SWITCHBOARD POLISH.

For polishing white marble switchboards the following dressing may be applied with white flannel: Ten parts white wax, two parts Japan gold size, and 88 parts turpentine.

HOW TO MAKE METAL POLISHES.

It is not difficult for any person to make his own metal polish. It can be done cheaply and will probably give him better satisfaction than the polish he buys. Here are a few recipes for good polishing soaps:

1. Twenty to 25 pounds liquid curd soap, intimately mixed with about 30 pounds of fine chalk and one-half pound Venetian red.

2. Twenty-six pounds liquid cocoanut oil soap, mixed with 12 pounds tripoli and one pound each of alum, tartaric acid and white lead.

3. Twenty-five pounds melted cocoanut oil saponified with 12 pounds soda lye of 38 to 40 degrees B., after which three pounds rouge, three pounds water and two ounces ammonia are crutched in.

Polishing soaps are generally cut into cakes and stamped or pressed and brought into commerce with directions for use. The directions generally state that a small quantity of the soap is put on the metallic article to be polished with a damp flannel and rubbed until the desired polish is obtained.

PASTE FOR MOUNTING PURPOSES.

To prepare a paste for mounting purposes.—Mix three-quarter ounces of starch with a little water to form a smooth cream, and pour on it sufficient boiling water to make 10 fluid ounces. Take one-half ounce of glue, allow it to soak in cold water till quite soft, pour off the excess of water, melt the glue down by gentle heat, and stir into the paste previously made. Now add one drachm of alum and a few drops of oil of cloves and stir well until dissolved. If the material should dry too hard, add one or two drachms of glycerine.

COLORLESS VARNISH.

Colorless varnish for use on fine labels or other prints, as well as for white wood and other spotless articles, is made as follows: Dissolve two and one-half ounces of bleached shellac in one pint of rectified alcohol; to this add five ounces of animal boneblack, which should first be heated, and then boil the mixture for about five minutes, filter a small quantity of this through filtering paper, and if not fully colorless, add more boneblack and boil again. When this has been done, run the mixture through silk and through filtering paper. When cool, it is ready for use. It should be applied with care and uniformity.

COST AND HANDLING OF GLUE.

More than $7,000,000 annually is spent in the United States for glue and yet few people know how to buy or use it. Made up properly the better grade requires 39 pounds of glue plus 61 pounds of water to give 100 pounds of liquid glue ready in the pot for joining hard wood, says the Wood-Worker. From the cheap glue we must take 42 pounds of glue plus 58 pounds of water to get our 100 pounds of glue liquid. The better glue requires 10 per cent less glue, but 10 per cent more water in order to get the same quantity of liquid from both, namely, 100 pounds of exactly the same fluidity of body.

The difference between the two glues in regard to strength is fully as large as the

difference in spread. The better grade carries a strain of at least 47 pounds, while the other only resists 39 pounds.

To get the cost, multiply the required number of pounds of dry glue with the price, and we have the cost of 100 pounds of liquid. For the joint glue we need 39 pounds of glue (and 61 pounds of water) costing 12 cents per pound dry glue, or $4.68 for 100 pounds liquid glue. For the lower grade we must take 44 pounds glue (and 56 pounds of water) at 9 cents per pound dry glue, at a cost of $3.96 for the 100 pounds in the pot.

Both glues give the same quantity, namely, 100 pounds of liquid of exactly the same body, and the 100 pounds glue liquid from either will, of course, cover exactly the same surface. To use the better grade costs $4.68; to use the lower grade, $3.96, or 72 cents less. The cost is in favor of the lower glue if the strength of the work done is to be ignored, but for the general use of the wood-worker the better grade will, in the long run, be found the cheaper.

UNCLE SAM'S WHITEWASH RECIPE.

A whitewash used on government buildings is made as follows: Take a half bushel of unslacked lime, slack it with boiling water, cover during the process to keep in steam, strain the liquor through a fine sieve or strainer. Add to it a peck of salt previously dissolved in warm water, three pints of ground rice boiled to a thin paste stirred in while hot, half a pound of Spanish whiting and one pound of glue previously dissolved by first soaking in cold water and then by cooking in a small pot hung in a larger one filled with water. Add five gallons of hot water to the mixture, stir well and let stand a few days covered as nearly airtight as possible. It should be applied hot, for which purpose it can be kept in a portable furnace.

TALLOW FOR CUTTING TOOLS.

Tallow is better than the best lard oil in cutting threads in iron. A reader of the American Machinist tells how he accidentally found this out. He was cutting 1-inch taps and found it impossible to use the oil furnished him. Seeing an old piece of candle on the shelf he tried it with success. It is cleaner, does not run, and on small work the heat from the friction of the cutting tool and the center is sufficient to melt it as the tool goes along. In cutting inside threads it stays where needed and is considered a great improvement over oil.

For cutting threads on copper use beeswax.

TO MAKE CELLULOID NON-INFLAMMABLE.

A process of rendering celluloid non-inflammable has been patented. To 25 parts of celluloidine, dissolved in a sufficient quantity of solvent, are added six parts of chloride of magnesium dissolved in either alcohol or methylated spirit and three parts of pulverized pure asbestos. These constituents are worked into a paste and may be applied either during or after the process of manufacture.

ANTIDOTE FOR AMMONIA FUMES.

Employes in ice and refrigerating plants are sometimes overcome by the fumes of the ammonia used in the process. In such cases a good stiff drink of vinegar will help to counteract the action of the ammonia, revive the unconscious, and in many cases save life. If the victim is unconscious, it may be necessary to pry his jaws open to get the vinegar down.

VALUABLE METHOD OF PRESERVING BLUE PRINTS.

The superintendent of a large car shop thus describes his method of preserving blue prints. His first method was to fasten the prints on ordinary flat sheets of pasteboard. These answered fairly well for a time and kept the prints flat, but the pasteboard became broken and oil-spotted. He then hit upon the idea of using thin sheet iron as a backing, and this proved eminently satisfactory. All the prints in common use in the shop were first pasted on these pieces of sheet iron, then both sides were varnished over, so as to make the paper oil and waterproof. After being subjected to this treatment, these prints can be hung up near the machines. They are always flat, clean and clear, and they can be filed away in small shape when not in use. Moreover, they are practically indestructible, because when soiled they can be put under the hose and washed off. The plan has been in use for about six years, and has proved very satisfactory.

CORE-DRAWING MORTISING CHISEL.

A writer in the Wood Worker thus describes a handy tool which any mechanic can easily make.

Take an ordinary chisel and file the bottom of groove a trifle wider than top, as in-

dicated at C in sketch, and a trifle wider at A than B, he will have no more trouble with tight cores. A long bevel on inside edges, as indicated by dotted lines, also blunt bevel on lips, will greatly improve the drawing qualities of the chisel.

ATTACHING A LIGHT WATER-JACKET TO GASOLINE ENGINE.

In a paper read before the Institution of Mechanical Engineers, London, Capt. C. C. Longridge described a novel, but simple method of attaching a water-jacket to the cylinder of a gasoline engine. Reference to

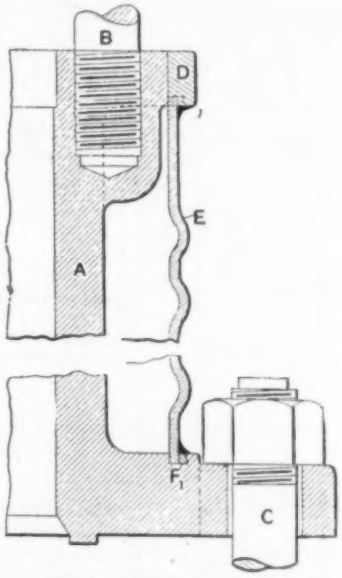


Fig. 1.—Showing How Water Jacket is Attached

the cut, Fig. 1, will make plain the following explanation: A the cylinder; B C studs securing cylinder head and frame; D iron or steel ring forced over the cylinder head and grooved to receive the jacket; E steel metal jacket; F F copper wire calked into groove; black surfaces represent solder if added.

He also describes a new combined inlet and exhaust valve for gasoline engines. Referring to Fig. 2: The exhaust valve E is recessed to receive the inlet valve D. F the cap of the exhaust valve spindle, is actuated by a two-to-one shaft and rod, not shown.

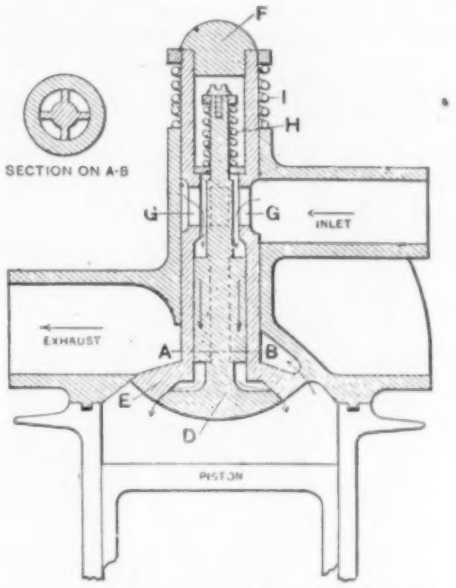


Fig. 2.—D'equevilly Combined Inlet and Exhaust Valve

I is the exhaust valve spring; H a weaker spring for the inlet. The shock of the exhaust spring closing, bounces the inlet valve at the same moment. The inlet valve stem is fluted, as shown in section across A B, forming channels for the charge to the head of the valve.

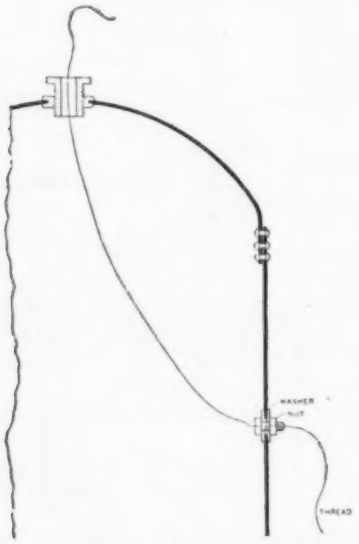
TO KEEP INK BOTTLE IN DRAWER.

To keep the ink bottle, which is only used occasionally, always handy and at the same time out of your way, says the Draftsman, fasten a piece of pine about 1 inch thick and 2½ inches square, with a hole in the center the size of the bottle, in a corner of the instrument drawer; there is no danger of tipping the bottle over here and it is always ready for use.

The turning on of a closed electric light has been found sufficient to ignite vapor ether when in a small room.

REPAIRING A RANGE BOILER.

An ingenious method of stopping a leak in a range boiler, which was too large to solder, is described in the Metal Worker. The plumber made a perfectly round hole at the point of leakage, and large enough to take a ¼-inch bolt with a soft washer in the inside. The bolt and washer were secured together and dropped into the boiler through the hot water opening at the top,



Drawing in the Bolt

a piece of thread being tied to each end of the bolt. The lower end of thread was then fished out through the hole, with a wire; the bolt drawn through and another soft copper washer put in the outside. Cement was freely used and the washers set up tight by tightening the nut. The same scheme can be worked in mending pipes and tanks where the material is too thin to tap and plug.

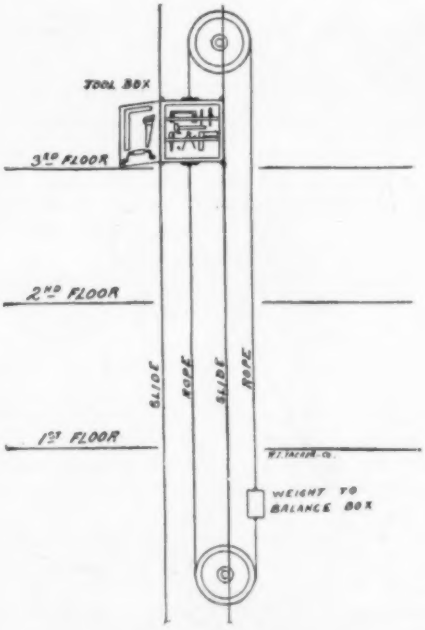
ATTACHMENT FOR LONG FILES.

The file attachment illustrated herewith is something which I find very useful, especially for heavy work, such as plow filing, says a writer in the American Blacksmith.

As is clearly shown, the device consists simply of a ¼-inch rod, one end of which is bent to hook over the end of the file, while the other end passes through a hole in the handle and is threaded to receive a nut. By placing a block under the rod and tightening up on the nut, the file may be given a slight bow downward. This opens the teeth and makes the file cut better. In my opinion, also, it will last longer.

A TOOL BOX ELEVATOR.

The accompanying drawing shows an arrangement that will enable the miller to have his tools on any floor he desires by simply pulling a rope, says the American Miller. The device consists of two sheaves on which a rope is placed. A tool box is



fastened to the rope, to run between two guide posts. On the opposite side of the rope a weight is placed to balance the tool box.

To Strengthen Long Files

Philadelphia's High Pressure Water System

A huge trunk 20 inches in diameter, reaching its octopus-like 8, 12 and 16-inch arms in every direction; a great pumping station, supplied from the Delaware river by means of a 36-inch suction main and having 10 pumps capable of delivering 1,200 gallons of water per minute at 40 revolutions against a pressure of 300 pounds per square inch; above all, each of the large pumps driven by a 280-horsepower gas engine having connection with the city gas mains for fuel and ready to start up at full power any moment without delay or loss. This, briefly told, is the high pressure water system which is to protect Philadelphia's business center, independent of fire engines and of the mains for domestic supply; a system which will carry a great volume of water to the highest floors of tall office buildings and will minimize loss of property and life and reduce insurance rates, in the district protected, 25 cents per $100. The expense may be easily figured in dollars and cents, but it must be placed against inestimable gain.

The building occupied by the pumping plant is 72 by 140 feet, and, besides the ten 11½ by 12-inch vertical, direct-acting Deane triplex pumps already mentioned, has two 6½ by 12-inch pumps of the same type, having a capacity of 350 gallons each and driven by 125-horsepower gas engines. The smaller engines are direct-connected to the smaller pumps through friction clutches and drive electric ignition generators of 7.5 k. w. each and the air compressors supplying air at 200 pounds pressure for starting the main engines. The heavy pumps are brass-fitted throughout, in order to be started up after long periods of idleness, and may be worked singly or together. Their construction is perfectly adapted to their use and they discharge into the common 20-inch pipe.

Where an ordinary water main would not be able to stand the high pressure, and would leak at the joints and waste pressure, these thick, close-jointed mains meet all the requirements. Altogether there are nine miles of pipe weighing 6,500,000 pounds. The pressure in the fire mains is controlled automatically by an electric motor acting on a valve. It may be held steadily at any point under 300 pounds, while a spring relief valve prevents it from rising above that amount.

The Philadelphia equipment is most complete and it is estimated that it will do the work of 40 fire engines with great economy. It is the first city to use gas engines in its pumping station, other cities having obtained their pressure from fire boats or reservoirs.

With four pumps working at 300 pounds pressure, over 40 mighty streams of water

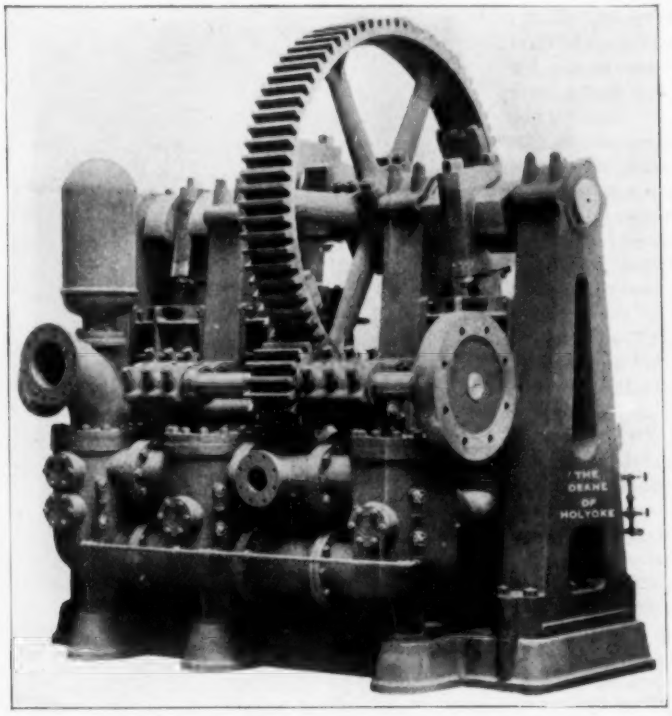
Eighteen High Pressure Streams Thrown in Test of Philadelphia's High Pressure Water System

were forced to a great height in the test of the Philadelphia high pressure fire water system which took place Tuesday, April 19. On the day before the engines of the system had been given a severe test for the benefit of a committee of insurance underwriters. The first engine was started up in a moment by the smallest number of men (3) ever likely to be in charge. Afterwards the entire system was started. The test was for an engine, designated by the committee, to work continuously for 12 hours. With hardly a break the mighty engines and pumps demonstrated their power.

The tests on Tuesday were of a more spectacular nature. Eighteen streams through 2½-inch hose, eighteen 1½ and 1¼-inch streams, supplied by three hydrants, three lines connected to the 3½-inch hose attached to a high pressure hydrant and single streams through 3½-inch hose

comprised the magnificent display. A single stream, handled by one man was thrown to an enormous height, almost to the top of a 21-story building near. Water tower streams were thrown with results greater than the capacity of several fire engines.

The plan submitted by Engineer Geo. W. Jackson to the Commission on High Pressure Water Systems for the City of Chicago



High Pressure Pump for Philadelphia Fire Service

is similar to the Philadelphia system in many respects. However, Chicago's network of sewers and water mains, her tunnels and her prospective subway make the laying of a new system of mains a difficult matter. The proposed plan involves some interesting features and is on a gigantic scale. The plan is for a main conduit or tunnel 8 feet 4 inches by 6 feet 4 inches and 9,000 feet long placed at the center of the Chicago river about 50 feet below the river bed. From this main conduit 4-foot laterals to extend on designated streets to within 100 feet of the dock line; and 4-foot vertical shafts from the laterals to within eight feet of the street line. The large conduit carries a 36-inch pipe and if future conditions require it a second pipe can be placed above the first. The horizontal laterals and the vertical shafts are supplied with 12-inch pipe and to each is connected two 8-inch cast-iron conductors able to bear a hydrostatic pressure of 800 pounds per square inch. The conductors have the necessary valves and fire hydrants. The plan calls for nearly 3½ miles of conduits and about 58½ miles of pipe, the 36, 24 and 12-inch pipe to be of lap welded steel having welded steel flanges, the high pressure test for the largest size being 1,800 pounds per square inch. It is recommended that 4-inch mains be run from the high pressure main to tall buildings and that a sprinkler system worked by compressed air be connected thereto. The 7-foot water tunnel supplying the Harrison street pumping station would be able to supply the new system, also. The tunnel has a capacity of 72,000,000 gallons per 24 hours; the station a pumping capacity of 33,000,000 gallons per 24 hours and the high pressure system is designed for 43,000,000 gallons per 24 hours. A water supply from the river would be undesirable because of the sediment it contains. A telephone line in connection with the mains and for the use of the Fire Chief is another improvement suggested.

It is estimated that a system having 10 fireboats for the protection of the business district would cost $791,940. For the district included from 12th street to Chicago avenue and from Halsted street to Michigan avenue, a high pressure system fully equipped would cost $3,203,480 and by using the fireboat "Illinois" for the present, construction could be begun with the funds now on hand.

Gas engines, because of their great economy, it not being necessary to keep up pressure at all times where they are used, are meeting with high favor and, beyond doubt, the future high pressure water systems of our great cities will use them exclusively.

Send for the Popular Mechanics' premium list.

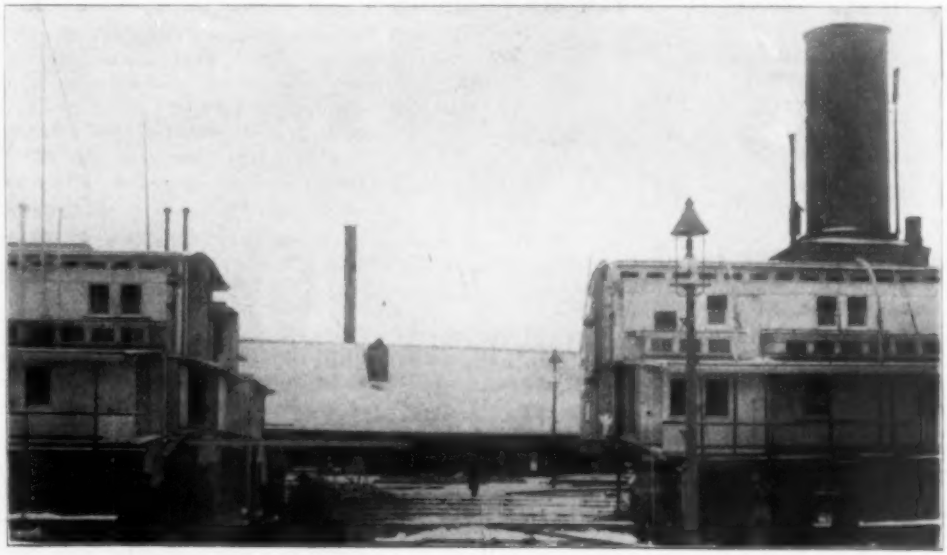
How a Lake Steamer was Lengthened 72 Feet

Two Great Lakes vessels will have undergone the operation of being cut in two, pulled apart and lengthened in the middle by the opening of navigation this season. The City of Buffalo, a passenger boat, recently was lengthened 42 feet in this manner at Detroit and the same operation has just been begun at Lorain upon the steamer Republic of the Republic Iron Co., at a cost of $75,000. She is to be lengthened 72 feet which will make her 364 feet when completed and which will increase her carrying capacity by one-half and will admit of more hatches and better equipment for ore handling machinery.

The lengthening of the City of Buffalo 42 feet in the middle is also regarded as a notable achievement in Great Lakes shipbuilding. The City of Buffalo is a passenger and package freight steamer built of steel. She was a ship of 2,398 tons burden. The work of lengthening this vessel cost about $170,000.

After being cut in two the forward part of the boat, weighing 1,000 tons, was moved by the engine of the dry dock plant and two powerful horsepower capstans. Just 40 minutes were required to make the pull of 42 feet and when stopped it was almost perfectly plumb with the part of the vessel which had not been moved. By this change in the length of the vessel the freight capacity is increased 50 per cent. The speed of the boat will not be affected in

Bow of the Steamer City of Buffalo, Before Being Moved, also the Blocks, Tackle and Ways.



The Steamer City of Buffalo, After She Had Been Cut in Two and Pulled Apart, Preparatory to Being Lengthened

the least, and she will not in the least be weakened by the operation through which she has just passed.

The cut was made just forward of the engines. The beam below the waterline is increased by three feet. Both forward and aft of the new section considerable of the plating had to be removed and some of the frames changed. The lengthening of the City of Buffalo was done under the direction of Mr. Frank E. Kirby, who originally designed this boat.

War Automobile in England

Patterned After American Machine it Becomes Part of the British Army Equipment

Great phalanxes of war automobiles arrayed against each other, with rapid-fire guns belching forth fire and lead and clouds of smoke from either side, may be the battle scene the war correspondent of the future will be called on to describe. Already the automobile has proved a success, but as other nations usually wait for Americans to establish new innovations in battle, as they did the torpedo, the submarine mine, the submarine boat, the monitor battleship, etc., maybe they are waiting for Americans to first demonstrate the utility of this new

Armored Motor Mounted with Maxim Gun

fighting automobile. Well, in reality, the Americans have demonstrated it, but not in an American war, and perhaps that is what is yet required. Americans took a war automobile into South Africa during the Transvaal war and it proved of such help to the British that they have since made the automobile a part of their military equipment. At the gunnery establishment at Whale Island the war automobile—the British call it an "Armoured Motor"—can be seen in almost daily practice and its expeditious and reliable work has won for it great prominence. Recently an exhibition of its performance was given before the king, who was greatly impressed. The British "Armoured Motor" is equipped with Maxim guns. During the king's visit the gun was fired rapidly at targets while speeding at 20 miles an hour with an accuracy that amazed all the visitors.

TWIN CITIES TO HAVE DOUBLE-DECKER CARS.

Double-decked street cars are to be placed in service in St. Paul and Minneapolis to aid the inhabitants of those northern twin cities to better enjoy their short but delightful summers. The lower deck is arranged similar to an ordinary street car, except that the top is flat to provide for the seats arranged crosswise on the top deck. The entire seating capacity of the double decker is 52. Passengers enter the upper deck by means of a neat iron stairway at the forward end. The stairs are not spiral as in the case of most other double deckers. The cars were built in the shops of the Twin City Rapid Transit Company, by which they are to be operated. They are of very substantial construction and each is capable of developing 250 horsepower each.

A carving knife 30 feet long and as sharp as a razor is to be exhibited at the St. Louis world's fair. It cost several thousand dollars and is of American manufacture. The blade is of the finest steel and the handle is beautifully carved and polished.

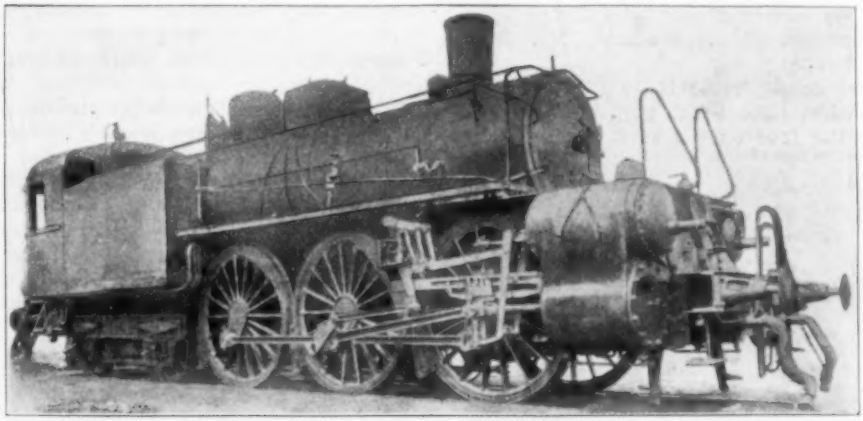
At the greatest ocean depth ever discovered, sounded during a cruise of the Albatross in the Pacific, the temperature was only 35 degrees. The sounding was done near the island of Guam. Prof. Agassiz was in charge of the expedition.

Italian Locomotive Has Enginemen's Cab in Front

The powerful new four cylinder compound locomotives in use on the Adriatic Railway, Italy, have the enginemen's cab in front of the boiler, the chimney coming behind and next to the water tender. This arrangement, says the Railway Review, enables the use of a furnace of exceptional width without raising the boiler to a height impracticable on the railways, for the firebox drops into the free space above the low wheels of the usual front truck. Arranged conduces to economy of power; but two distributors are used for the four cylinders and Smith's system of segmental valve rings is employed.

Front View Italian Locomotive.

The position of the cab gives the enginemen a fine range of lookout and considerably lessens the dangers of railroading. This 4-cylinder compound locomotive is superior to any other now in use. In daily service it hauls five times its own weight at a minimum expense, on one trip with a



Rear View Italian Locomotive

in this manner a value of nine pounds of steam for each pound of coal, an increase of two pounds over that of the former arrangement, results. In fact, the entire mechanism load of 413 tons using but 45 pounds of fuel per real train mile, with a maximum speed of 65¾ miles per hour. Its power of acceleration is remarkable.

The next issue of Popular Mechanics will contain an article on how a warship is first built on paper before a single bolt is driven. You will be surprised to learn of the great number of drawings required for a battleship's construction and of the minuteness and accuracy of the specifications.

Illinoisan Building An Airship

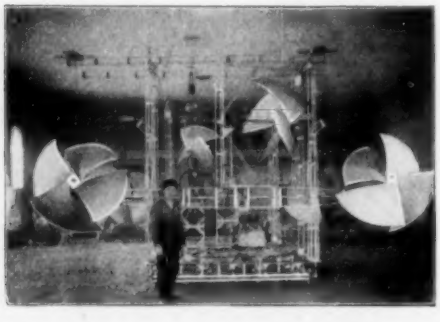
Ingenious New Construction to Enter St. Louis Aerial Races

An Illinoisan is the latest to enter the contest for the $100,000 prize offered the winners of the St. Louis world's fair aerial races. William Reiferscheid, of Streator, Ill., has built an airship which he thinks will outclass those of Santos Dumont and

Balloon of Reiferscheid Airship

all the other aeronauts, for he says his ship will do more than any of them. It will fly at will in any direction desired; turn, lower and raise in the air at the guidance of the operator. The device consists of a balloon and framework below supporting six shiftable propellers, a car and the motive power. In describing the construction of his machine, Mr. Reiferscheid says:

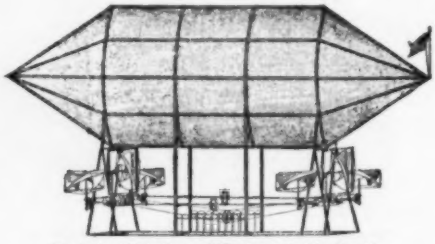
"The ship's frame is 30 feet long by 8 feet wide. Six 4-feet propellers drive the ship; the four on the sides pull up, down,



Propellers of Reiferscheid Airship

forward and backward, and the two center propellers steer the ship, turning it on the spot or in any circle desired. The balloon is 75 feet long by 25 feet in diameter, with a lifting capacity of 1,680 pounds. The ship, motor and balloon weigh 1,200 pounds. The frame of the ship is built of Shelby steel tubing; the propellers are aluminum; every journal is ball bearing.

"My greatest difficulty has been in securing the proper motive power. I am now having a rotary gasoline motor built, which will weigh 200 pounds and will give me twenty-five horse-power. My present motor is of eight horse-power and weighs 250



Sketch of Design of Reiferscheid Airship

pounds. My new motor can also be used for steam power. I believe it is the simplest and most powerful motor ever built. Necessity is the mother of invention. When I found that I could not get what I wanted through other sources, I resolved to make one myself, and I have succeeded beyond my expectations."

NODIUM IS LIGHTER THAN ALUMINUM.

A new metal, resembling aluminum, but of lesser weight, has been discovered by Albert Nodon, the French engineer, and after him called "nodium." The metal is manufactured by an electric process. In color, lustre and structure it is almost exactly like steel. When molten its specific weight is only 3.4. Its resistence against breaking is given at about 20 pounds per square of 0.04 inch. Its constancy in the air is higher than that of aluminum. Its ductility is between 6 to 8 inches; its malleableness can be compared to that of bronze It melts at about 600 degrees. It is suitable for being cast into forms. The conductibility for electric current is as high as that of copper of equal weight.

A subscriber in the South writes us that money is so free in Texas that dogs are wearing gold-buckled suspenders to keep up their pants.

First Lessons in Blacksmithing

Every young man, no matter what his intended occupation or profession, should know something about forging, welding a d shaping metals. The work is at once fascinating, useful and practical. This series of articles will extend through several issues.

PART I.—TOOLS AND MATERIALS.

During the summer months of "vacation," when the other fellows are busy with sports, the young man who is mechanically inclined will find both pleasure and profit in a few hours spent at the forge, learning the principles of welding and forming. The knowledge gained by these "tinkering times", be it ever so little, may be of great benefit later in life.

Anvil

The first thing to consider will be the necessary tools such as a forge, anvil, etc., the expense of same, and a suitable room in which to work. A room or corner of a room can usually be found in some out-building or shed, or a small "lean-to" consisting of a roof and sides can be built against another building. The principle requirements of the room or building are a tight roof and plenty of light.

The equipment of tools may consist of only the necessary forge and anvil, or a larger and better assortment, according to the condition of the young man's pocketbook. A fairly good assortment of tools and sufficient materials to commence work with can be had for $25, as follows:

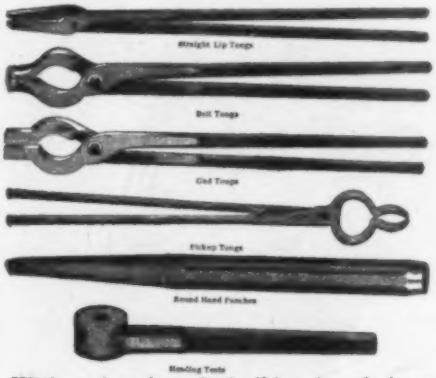
One 100-lb. anvil	$ 9.00
One Champion lever forge, 18-inch hearth, 8-inch fan	7.00
One 3½-inch jaw machinist's vise	4.50
One hardy, to fit in anvil	.30
One 1-lb cross pene machinst's hammer	.50
One 2-lb. ball pene machinst's hammer	.75
Two pairs blacksmith's straight-lipped tongs	.75
One 10-inch flat mill file	.15
One 10-inch flat bastard file	.20
Three or four lengths of second-hand stovepipe for forge	.25
100 lbs. of soft coal	.30
One bar each ⅝-inch, ½-inch, ⅝-inch round iron	1.30
Total	$25.00

By buying the anvil, forge and vise second-hand the above figure could be reduced to perhaps $15, but it would be best to get some one who knows the value of such goods, to buy them, as second-hand goods are often priced beyond their value.

Besides the above named tools, a few nails and boards for a bench, a pail or keg for a water tub, and two or three boxes will be necessary, which can be obtained for practically nothing. The forge may be set up in any part of the room desired, but about two or three feet from the side of the room, near a window, or where a good light will strike the anvil, will be the best place. Connect the stovepipe with the top of the hood on the forge, and run it out through the roof, or the side of the building. When run through the side of the building, an "elbow" and extra length of pipe will be necessary on the outside to prevent the wind blowing into the pipe and driving the smoke back into the room. The anvil should be set on a strong box or block of wood directly in front of the forge, with the horn towards the left.

Hardy

It should be three and one-half feet from the forge, and just high enough so the face of the anvil will touch the knuckles of the hands when standing up beside it.



With a few boards build a bench in any convenient part of the room where there will be plenty of light. It should be from 20 to 24 inches wide, and a little higher than the anvil. About midway, securely fasten the vise with screws or bolts.

Place a box on the floor near the forge for a coal bin, and another box on end to the right of the anvil for a stand, on which to place the hardy, hammers, etc. A pail or keg near the forge should be filled with water for a cooling tub. The bars of iron should be stood on end in a corner, or laid on the floor near the wall.

A common fire shovel will be necessary to shovel the coal, and a poker and pointed rod for stirring up the fire, which can be made by the young man himself. About two quarts of fine coal ashes should be dumped in the fire pot of the forge, and the hearth filled up with coal. Good coal for blacksmithing should be free from dirt and small stones, and is preferable if in small lumps about the size of a hen's egg, as anything fine like sweepings usually contains more or less dirt. The coal should also be free from sulphur, and any lumps looking yellow should be thrown out. Good coal looks bright and shiny; and will "coke" (swell up and spread apart), when burning.

Portable Forge

Before starting the forge, if a new one, an oil cup filled with good machine oil should be procured (costing perhaps 25 cents), and the bearings of the fan and drive wheel under the forge hearth oiled, and kept oiled to prevent heating and sticking. Oil these parts often, using only a few drops at a time, as too much oil is nearly as bad as not enough. To start the fire in the forge, shovel out the coal ashes in the center of the fire pot until the air slots in the "tuyere" are reached, throwing away the ashes shoveled out. Fill up the space with dry pine shavings, and touch a fire; when burning in good shape draw up the coal around the shavings, blowing gently until the coal begins to burn, then more coal can be drawn up, and more blast given it until the fire is thoroughly made.

Machinist's Vise

The fire being ready, the two pokers will be the first to make, as they are a necessity to keep the fire in shape. With the hardy in the anvil, cut off two pieces of ⅜-inch round iron two feet long, which can be done without heating. Place one end of one piece in the fire and heat until the end is white hot; bring it out to the anvil and hammer it out to a square point tapering back about one inch; when to a square point, hammer down the corners, which will make a round point, and it is done.

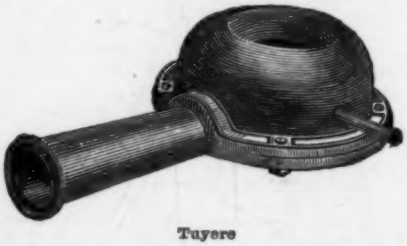
Heat one end of the other rod back for three inches to almost a white heat, and hammer out flat for fully three to four

Ball Pene Hammer

inches, to about ⅛ inch thick, cutting the corners off the end with the hardy to make it pointed. At the base of the flattened part bend it well back, then bend the point forward gradually, making a half circle, which makes a first class poker.

The pokers made, the next step will be how to run the fire, and keep it in the best condition. The coal which is burning will soon burn away as the fire is used, and more coal must be put on to take its place. The best way to do this is to keep a good supply of fresh coal drawn up around the fire, and as the fire is used, that which has coked can be pulled over into the fire, thereby keeping a supply of coal constantly in the fire. As the coal burns away, more or less settles to the bottom of the fire in the form of a hard cinder, which should be cleaned out quite often by means of the sharpened rod.

To do this, poke back the live coals to each side of the fire, and lift out the pieces

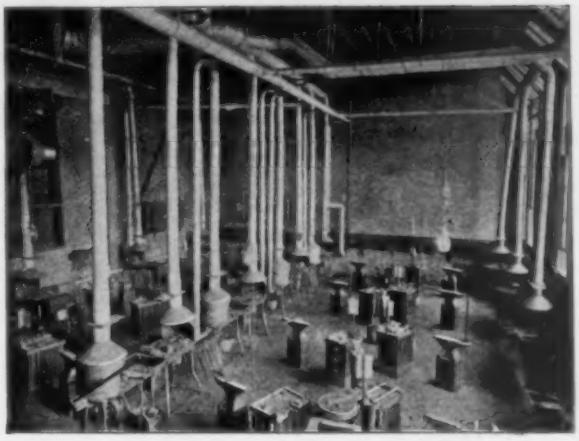


Tuyere

of cinder which are quickly recognized by their weight and hard, ringing sound, draw the coals back in place and the fire is ready to use. Coal on the forge should be kept

sprinkled with water to keep down the dust and to prevent the fire from spreading out and covering too large a surface. The important point to remember in running the fire is to keep it well banked up, and the heat concentrated to the center. A flat, shallow fire is a poor fire for an expert smith to do anything with, much less a beginner.

In the next chapter we will take up heating, forming and welding.



Forge Room, Manual Training School, Cambridge, Mass.

USE OF WOOD ALCOHOL FOLLOWED BY BLINDNESS AND DEATH.

Inhalation of the fumes of wood alcohol while shellacking in a closed room for several days in succession has caused a number of deaths, while through various other means the number of fatalities from poisoning with wood alcohol is increasing. Blindness, too, is another of the terrible effects of this chemical when taken in large quantities, although it varies greatly in different individuals, there having been cases in which two ounces caused death.

The fact of the matter is that, despite the drug's known harmful effects, manufacturers use it in order to put cheap essences, alcohols, etc., on the market. The revenue tax on grain alcohol is $2.17; on wood alcohol there is no tax, and it may be had at 50 cents per gallon. This is a great temptation to the manufacturer. Many of the deaths from wood alcohol poisoning have been after a spree on either lemon essence, Jamaica ginger, or cheap alcohol. The body excretes the poison very slowly, the victim drinks all he can get so long as he is able, the poison accumulates; the system cannot overcome its effects. The result is blindness or death. Sometimes blindness does not result until several days after recovery from intoxication, on the other hand death has followed in 24 hours.

The uses of wood alcohol are many. It enters into the manufacture of ether, formaldehyde, chloroform, methyl chlorid and shellac varnish; it is used extensively in the arts and in many extracts, but taking any great quantity of any liquid containing it should be avoided. It has a sharp burning taste, but an agreeable odor; burns with intense heat and a bluish flame.

EARN YOUR FORGE YOUR TOOLS

Necessary to use in the series of lessons on blacksmithing. The outfit need not cost you any money. To encourage our readers to take up this branch of manual training, the publishers of POPULAR MECHANICS have arranged to purchase anvils, forges and all necessary tools at manufacturer's prices. and these are offered for small clubs of new subscribers to this magazine. The articles are all strictly first-class and will last for years.

Skin Diseases

If you suffer from Eczema, Salt Rheum, Ringworm, Itch, Acne, or other skin troubles,

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will cure you.

As these diseases are caused by parasites, killing them without causing injury to the healthy tissue cures the trouble. It has cured many cases pronounced incurable and is absolutely safe.

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ENGLISH ROADS MAKE UNSATISFACTORY SHOWING.

The half-yearly reports of the principal English railways show that they have not experienced the remarkable prosperity enjoyed by American roads. For the last six months of 1903, compared with the same period of 1902, eight out of twelve main English systems reduced their dividends from ¼ to ½ per cent, while only four of them pay above 6 per cent and only six above 4 per cent.

The passenger traffic, according to English critics, shows a gratifying increase, but the freight receipts fell off severely. The introduction of electric tram cars, bad weather, general commercial depression and heavy taxation are the main causes cited by the British for the rather unpropitious year for English railways. At a recent meeting of the Great Western stockholders a resolution was introduced declaring that the enormous increase in expenditures over the increase in receipts made a consolidation of the leading roads of England necessary that material economies might be effected.

ELECTRIC CAR AIDS IN SAVING LIFE.

The arc headlight of an electric car was of great assistance recently in saving the crew of a lumber schooner which had anchored off the beach at Redondo, Cal., and, her chains breaking during the night, was blown on shore. The car was run to a position from which its light was thrown on the vessel and heartened up the crew magically, and also expedited the matter of getting a line to them, by which the rescue was effected by the life saving crew.

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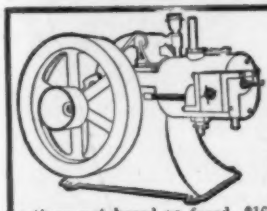

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THE PARACHUTE MAN—HIS FIRST ASCENSION.

"Come on! The band's all ready."

I was met with a roar of applause as I ran down the hotel steps. The band blared in salute, and the crowd opened up for me as I hastened. The parachute was stretched out from the straining balloon. As the man with me snapped the hooks on the ring, he showed me where the rope hung, and told me how to pull it when cutting loose. He was the excited one. I was in a semi-stupor. A bitter indifference filled me as I looked at the ugly, swaying monster which was to bear me to affluence or death.

"Let her go!"

With a cleaving of the air and a rush of sound like the coming of a cyclone, the balloon shot upward. I ran for the bar, grasped it and soared.

I tried to swing up on the bar. But the rush of the ascent straightened me, like an iron rod. I thought my arms would be pulled out. A sickness came over me, comparable to the effect of the start made by a high-speed elevator. Then the motion became more easy and I swung up on the bar. I was accustomed to gazing down from heights, and felt no fear as I stared at the fading crowd. I could see them waving hats and hands; could hear the band playing; and was conscious of a pleasant, dreamy sensation, and of a steady, easy rising from the ground. I ventured to bend a "crab" and make a few "ankle drops." It was as easy as when I was only a few feet from the ground. I glanced down again. The crowd appeared smaller and seemed to be walking away from me. I had commenced to drift. Now was the time to cut loose. I wished that I might stay where I was—taking chances with that limp bag of a parachute did not look to be safe. But it had to be done.

I caught hold of the rope, braced myself on the bar, and gave a short, hard pull.

Whish—my breath left me! For the first time fear—deadly fear—entered my heart. A jerk that nearly unseated me, and I was again sailing pleasantly through space.

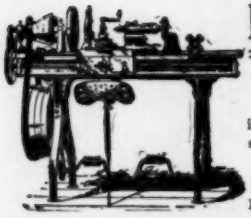
I ventured to essay a few additional feats, as the ground seemed to more closely approach me, and then I commenced to calculate as to the manner in which to strike the ground. Like many other problems, it settled itself. I struck it feet first in a corn field; was dragged along and scratched up, and came to consciousness in the arms of my new manager, who was alternately cursing me for getting killed and blessing me for having saved his skin and the four hundred and fifty dollars.—Outing.

FROGS LEAVING MINNESOTA.

The raising and catching of frogs is quite an industry in Minnesota. Last year 5,000,000 frogs were marketed valued at $100,000. The legs are put in cold storage in St. Paul and shipped out to all parts of the country. Owing to the clear, pure waters of the Minnesota lakes the flavor of the frogs caught there is said to be unequalled.

CLOCK CALLS OUT FIRE COMPANIES.

A fire alarm sounded in lower New York and continued with such an ominous clamor that other alarms took up the blatant message and citizens aroused in fear. It was a clear, cold night in January of 1848. Several fire companies hastened to their duty and soon were speeding madly down Broadway. At Trinity Church they paused, for the source of the alarm became evident. The church clock was out of order and had begun to strike and continued striking for about two hours, or until it ran down, the clear, cold night air making it sound especially portentous.



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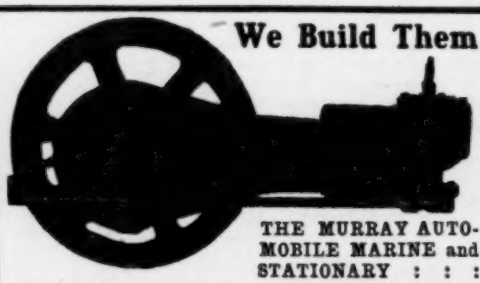

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JAPAN'S SEA TRAINING.

In the eleventh or twelfth century the Japanese were the most dashing pirates of the East—in fact, we might almost call them the Vikings of the East. They used junks—small ships with a scrap of sail, about the size of the little vessels in which the Danes once raided our own coasts. With these junks the Japanese roamed the seas, going everywhere along the Chinese main, ravaging the coasts, trading, and bringing home priceless works of art from China.

It was not until long afterward that the ruling authorities of Japan, under the great Emperor Hideyoshi, decided that it suited their purpose to shut off communication with the outside world and to live to themselves, trading merely with their own islands. The old Japanese Vikings were reduced to simple fishermen and the period of internal feudatory wars began, for at that time, at least, Japanese would fight because they loved it.

WHAT YOUR WEIGHT IN GOLD AMOUNTS TO

When it comes down to actual figures few people are not worth their weight in gold. The fact is that one $5.00 goldpiece weighs only about six and one-half times as much as one $1.00 bill, or .296 ounce avoirdupois, a $1.00 bill weighing .045 ounce. Very few people but estimate the weight of money wrong. In silver, of course, the weight is much greater, 100 pounds of dollars being equal to $1,309; of half dollars $1,818; of quarter dollars, $1,329; of dimes, $1,307.90; of nickels, $458.50, and of pennies, $147.80.

It would really have a greater numerical significance to say a person is worth his weight in paper, specifying the denomination, than to say he is worth his weight in gold.

HOW TO REMOVE STAINS ON DISHES.

To remove developer and other stains from dishes, says Photo Beacon, mix some salt with enough water to form a sort of paste, and rub the stains with this mixture with a piece of cloth. If the stains are of long standing, and this fails to remove them, rub the salt into the stains with a piece of pumice stone. This will remove any stains of any substance such as hypo, pyro, etc.

PATENTED A HOLE.

A hole in the end of a toothbrush handle once brought thousands of dollars to the sharp fellow who patented it. A little hook was given with each brush with instructions to hang up the brush, and the toothbrushes so provided sold higher than others just like them with the exception of the hole.

The patent has expired, however, and holes may now be put in the handles of brushes of any make.

BOYS' CLUB BEING ORGANIZED.

A club for boys interested in photography, electricity and other sciences is now being formed, more especially for boys living in Chicago on the South Side. Parties interested should address W. I. Wilcox, 4244 Langley avenue, for information.

A gentleman riding with an Irishman came within sight of an old gallows, and to display his wit, said:

"Pat, do you see that?"

"To be sure Oi do," replied Pat.

"And where would you be today if the gallows had its due?"

"Oi'd be riding alone," replied Pat.

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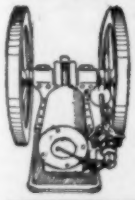

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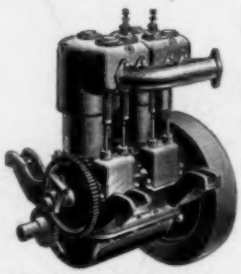

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WHAT 3 PER CENT A MONTH DOES.

A merchant once said to Peter Cooper, that he was about to borrow $10,000 for six months at 3 per cent a month.

"Why do you borrow for so short a time?" Mr. Cooper asked. "Because the brokers will not negotiate bills for longer." "Well, if you wish," said Mr. Cooper, "I will discount your note at that rate for three years." "Are you in earnest?" asked the would-be borrower. "Certainly I am. I will discount your note for $10,000, for three years at that rate. Will you do it?" "Of course I will," said the merchant. "Well," said Mr. Cooper, "just sign this note for $10,000, payable in three years, and give me your check for $800, and the transaction will be complete." "But where is the money for me?" asked the astonished merchant. "Your interest for thirty-six months at 3 per cent per month amounts to 108 per cent, or $10,800. Therefore your check for $800 just makes us even."

SUCCESS.

By John Trotwood Moore.

'Tis the coward who quits to misfortune,
'Tis the knave who changes each day,
'Tis the fool who wins half the battle,
Then throws all his chances away.

There is little in life but labor,
And tomorrow may find that a dream;
Success is the bride of Endeavor,
And luck—but a meteor's gleam.

The time to succeed is when others,
Discouraged, show traces of tire;
The battle is fought in the homestretch—
And won—'twixt the flag and the wire!

INVENTIONS TO ORDER.

The Popular Mechanics' Patent Bureau is prepared to furnish designs or working drawings for labor-saving machines of all kinds. It has a corps of one hundred mechanical and electrical engineers of extensive experience in designing and constructing wood-working and metal-working machinery.

Manufacturers who are bothered with mechanical difficulties in their shops or who desire to improve their products or decrease the cost of production, are invited to write us freely, stating their needs. All designs or inventions will be furnished under an agreement by which there will be no charge unless the work is acceptable, and if accepted, all patent rights will belong exclusively to the party for whom the designs are furnished.

A MAN WHO DID THINGS.

The story has been told before, but is worth repeating, especially for younger readers to whom it is new.

T. J. Patter, known to railroad men all over the United States as Tom Patter, was at the time of his death a few years ago, general manager of one of the largest railroads in the world. He was the telegraph operator at a little way station, who one wild night, when wires were down and a passenger train went through the bridge, took charge of the dead, cared for the wounded, settled fifty claims—drawing on the company therefor—burned the wreckage, sunk the waste iron in the river and repaired the bridge before the superintendent arrived on the scene. "Who gave you authority to do all this?" demanded the superintendent. "Nobody," said Tom, "I assumed the authority." Next month his salary was at the rate of $5,000 a year.

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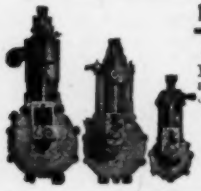

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ENORMOUS BALLOON CLOCK A FEATURE OF LEWIS AND CLARK EXPOSITION.

Persons attending the Lewis and Clark Exposition to be held at Portland, Oregon, in 1905, in commemoration of the memorable expedition, will have no difficulty in telling the time while on the fair grounds. A balloon clock having a dial 50 feet in diameter with electric lighted face will be suspended 400 feet above the grounds. A stationary balloon will hold it in place, where it may be referred to at all times from any part of the grounds.

The western fair promises to pass in spectacular review all the unrivaled features of a country where grain, fruits and flowers mature almost perfectly. Aside from the many remarkable exhibits, beautiful buildings and various unique features, the setting of the exposition is hardly to be equaled in America. On the shore of the beautiful Willamette river, in sight of many snow-crowned peaks, notably among them old Hood, and in easy distance of the Pacific coast, the exposition, commemorating an event of national import, is certain to draw a mighty concourse of people.

FISHING FOR SHAD ON THE DELAWARE.

When the fishing season opens up on the Delaware river the scene is one of great activity and interest. Before the great net, two miles in length, for hauling in the shad, can be lowered, all the debris that has collected during the winter months must be cleared away, and many a ghastly relic is brought from the depths while secrets are disentombed and dark mysteries grow darker.

The net is 10 feet deep at the outer edges and 30 feet deep in the middle. It is loaded on a great boat which is rowed out on the river. The captain then instructs the men in another boat where to row for the casting, throws them an edge of the net and pays out all of it as they row away. Then the haulers are signaled and the work of dragging in the net is begun. Seventy-five men and eight horses are required to haul it in. First comes a long rope, then gradually the net comes in sight and the men hold the ropes taut to keep the shad from escaping. Some do escape, the smaller ones through the meshes of the net, others leaping over. The water is lashed into a white fury in their futile endeavor, but slowly, surely, the net approaches the shore and the gleaming mass is seen writhing and struggling in the shallow water. Then the captain, in a boat, goes to the center of the mass and experienced workers pick the fish out by hand and put them into the boat. What few remain are removed when the net is hauled on shore.

The fishermen live in shacks along the river during the season and two casts are made each day.

FUEL OIL USED FOR LONG VOYAGE

Nine thousand three hundred barrels of fuel oil were consumed by the steamship "Nebraskan" in a trip of 12,724 nautical miles from San Diego, Cal., to New York, by way of the Straits of Magellan. The long trip tested the economical value of oil as fuel for ocean navigation thoroughly. One of the great differences made by the use of oil was that 12 men were saved from the fireroom and but three were required for tending the burners.

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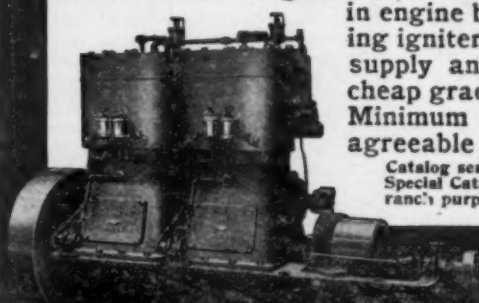

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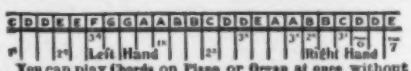

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HINTS FOR INVENTORS.

By Frederick Benjamin.
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THE INS AND OUTS OF PATENTS.

As the sixteenth century was the age of art, the twentieth is the age of invention. But our Raphaels and Michael Angelos of science do not work for fame; they are after money. And to get money from an invention it must be patented. Here is where many an ingenious idea, that could materially lighten the labor of the world and bring reputation and profit to its originator, is stranded, and despite the popular notion to the contrary, the inventor is usually his own worst enemy.

WHO CAN OBTAIN A PATENT.

Who may obtain a patent and the nature of the patentable invention are defined by the U. S. Revised Statutes, Section 4886, as follows:

"A patent may be obtained by any person who has invented or discovered any new and useful art, machine, manufacture or composition of matter, or any new and useful improvement thereof not known or used by others in this country, and not patented nor described in any printed publication in this or any foreign country, before his invention or discovery thereof, and not in public use nor on sale for more than two years prior to his application, unless the same is proved to have been abandoned."

WHAT MAY BE PATENTED.

The Revised Statutes of the United States provide that a patent may be obtained for "any new and useful art, machine, manufacture, or composition of matter, or for any new and useful improvement thereof."

Under this provision of the statute patents are granted for seventeen years:—

1. For any new and useful machine, manufacture, or composition of matter.
2. For any new combination of mechanical parts or instruments, whereby a new machine is produced, though each of the parts be separately old.
3. For an improvement in any known machine or article of manufacture, whereby it is rendered capable of working more beneficially, or its manufacture is cheapened.
4. For any new and useful process not wholly mechanical.
5. For a new vendible substance, new or improved in itself, whether produced by a chemical or a mechanical process.
6. For new improvements in any manufacture, composition of matter, or any art.

To be patentable a thing must be new and useful within the meaning of those words as used in the law, and it must also involve the quality of invention, as distinguished from mechanical skill.

HOW TO MAKE INVENTIONS.

To invent is to think. Inventions are ideas in physical shape or practical application. Anyone who can think, can invent. The power of inventing increases with exercise.

Accident frequently suggests new ideas, but the complete invention is usually the result of concentrated thought, careful investigation and persistent experiment.

An inventor, to attain the greatest success, must study his invention, no matter how simple it is. If he adopts invention as a profession he must study the subject as a lawyer studies law, the doctor medicine, or the engineer engines. He should first study the needs of the public, beginning with the simple ones, then find out the existing difficulties in the art or industry to which the need applies, and then strive to overcome these difficulties.

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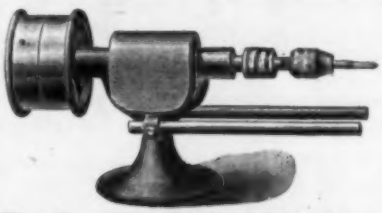

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in every industry, and there is ever a demand for new industries, so that the field of the inventor is without limit. The inventor should note the work done by hand and try to think of a way to do it automatically or by machine. He should consider the cost of the tool or machine or process, and try to think of a way to reduce the cost without impairing the quality. He should observe the product of an industry and see if it cannot be increased or improved. He should apply his thoughts to the problems of saving life, or property, or waste, or power, or time, or distance. When he has an idea which he thinks is new, he should put it in form of a working drawing or model, then study it with a view of making it stronger, or simpler, or cheaper, or in some way better. He should not get discouraged if he does not succeed at once or attain perfection. The world's greatest inventions were not developed in a day. In the beginning they were the crude embodiments of great possibilities, and now, after many years, they are not all perfect.

A patentable invention may be made by omitting one or more parts of a machine, or by changing the position of the parts, or by combining two devices in one, if by such changes a better result is accomplished.

An inventor should not give up because his invention turns out to be old. The fact that some one else has thought of the same thing is a compliment to his inventive powers. If he can invent one thing he can another. In conclusion, give your best thoughts and efforts to your invention, and nine times out of ten you will succeed.

United States Senator Platt, of Connecticut, in a speech in support of the Patent Laws stated that "two-thirds of the aggregate wealth in the United States is due to patented inventions." This is certainly not an extravagant estimate.

THE PATENT APPLICATION.

The Patent Office will take no notice of any device unless presented in a complete formal application, which includes, where admissible, a drawing made in conformity with certain rules and regulations, a clear and concise specification from which a skilled mechanic would be able to construct the device, and a condensed statement of the invention in the form of claims embodying what is thought to be its novel features; the whole attested by a duly acknowledged oath. In the specification should appear the advantages and conveniences to be secured by the invention in addition to a description by reference letters or numerals of the parts of the device, together with their co-operative relationship and interdependency. It is rarely possible that an inventor

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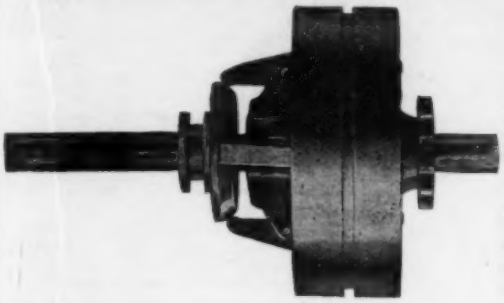

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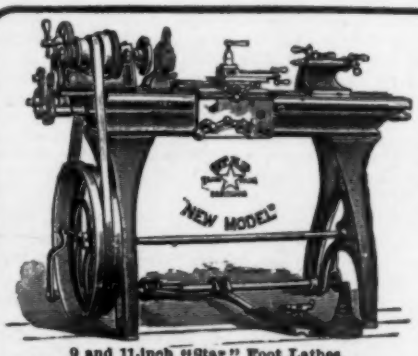

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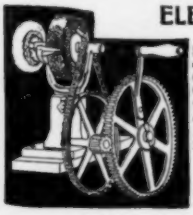

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can properly prepare his application and comply with all the intricate legal requirements. In view of the fact that through inexperience valuable features of inventions were often left unclaimed, and therefore unprotected, the United States Supreme Court has embodied the following warning to inventors in one of its decisions:

"The growth of the patent system in the last quarter of a century, in this country, has reached a stage in its progress, where the variety and magnitude of the interests involved require accuracy, precision and care in the preparation of all the papers on which the patent is founded."—Merrill v. Yeomans, U. S. Supreme Court.

There is only one way in which this accuracy, precision and care can possibly be secured, and that is by the employment of a trustworthy and experienced attorney. The inventor who is applying for his first patent is absolutely certain to blunder if he tries to make out his application himself. He may describe his invention perfectly but this will not protect it unless he covers it in the claims. It is in the preparation of the claims that great care and skill must be exercised if the patent is to have any protective value.

INTERFERENCES.

"An interference is a proceeding instituted by the Patent Office for the purpose of determining the question of priority of invention between two or more parties claiming substantially the same patentable invention. The fact that one of the parties has already obtained a patent will not prevent an interference, for, although the Commissioner has no power to cancel a patent, he may grant another patent for the same invention to a person who proves to be the prior inventor."

INFRINGEMENTS.

Infringement consists in the use, sale, or manufacture of something already patented, whereby the patentee suffers injury. Infringement occurs much less frequently than most people suppose, and in general, unless you have special reason to believe that you are infringing another's patent, the best way is not to give yourself trouble about it until some one troubles you.

To determine whether the use of a patent is an infringement on another generally requires a most careful examination of all analogous prior patents.

TRANSFERS OF PATENTS.

Every patent or any interest therein shall be assignable in law by an instrument in writing, and the patentee or his assigns or legal representatives may, in like manner, grant and convey an exclusive right under the patent to the whole or any specified part of the United States.

Interests in patents may be vested in assigns, in grantees of exclusive sectional rights, in mortgages, and in licenses.

An assignee is a transferee of the whole interest of the original patent or of an undivided part of such whole interest, extending to every portion of the United States. The assignment must be written or printed and duly signed.

A grantee acquires by the grant the exclusive right under the patent to make and use, and to grant to others the right to make and use, the thing patented within and throughout some specified part of the United States, excluding the patentee therefrom. The grant must be written or printed and be duly signed.

A mortgage must be written or printed and be duly signed.

A licensee takes an interest less than or different from either of the others. A license may be oral, written or printed, and if written or printed must be duly signed.

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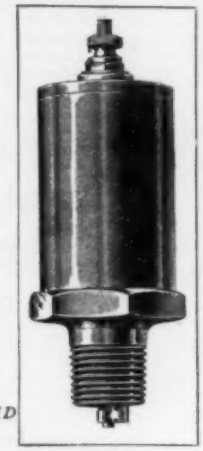

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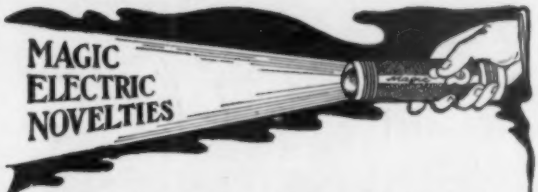

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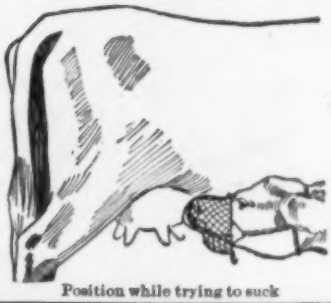

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Patents may be granted and issued or reissued to the assignee of the inventor or discoverer; but the assignment must first be entered of record in the Patent Office. And in all cases of an application by an assignee for the issue of a patent, the application shall be made and the specification sworn to by the inventor or discoverer; and in all cases of an application for a re-issue of any patent, the application must be made and the corrected specifications signed by the inventor or discoverer, if he is living.

(Continued next month.)

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That oft cause their cheeks to pale,—
Ride these Sailors of the Rail.

Great and strong is their true friendship.
Brothers, comrades, every one;
Happy greetings from their kind lip
Meet the lads, as from the run
They come home with some new tale
Of these Sailors of the Rail.

What their thoughts are when they sever
Suddenly Life's cord, and go
From this earthly "Run" forever,
No one else will ever know;
For alone they pass the Veil,
Silent Sailors of the Rail.

—Railroad Trainmen's Journal.

CONSUMPTION

CURED

By Dr. John Warren Walker's

ANTISEPTIC OIL AND BALSAM TABLETS

HOW THEY CURE:

By arresting the action of the tuberculous germs and driving them from the system—stopping the cough, fever, night-sweats and expectoration—increasing the appetite, nutrition, weight and vitality—soothing and healing the affected organs.

The tablets are pleasant and agreeable to take, and will give aid and encouragement to the most delicate stomach. Their action is rapid, regular, grateful, and one day's use will prove their good effect. Put up in jars of 700 tablets—an amount sufficient for six weeks' treatment at $5.00 a jar.

BANK GUARANTEE

In order that you may be *Sure* you are not sending me $5.00 for a remedy of doubtful value, and to prove by *practical test* that my tablets will do *all* and a *great deal more* than I have stated above, I will protect you fully in the following manner:

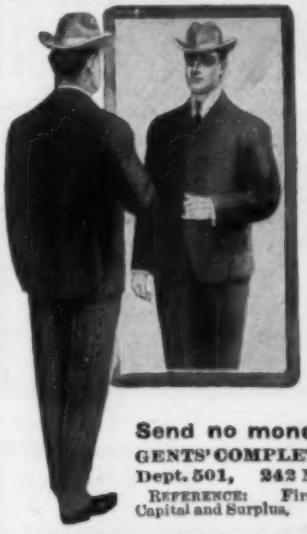
With each jar I will send you my check for $5.00 payable to your order. At the end of ten days if you find the tablets have not done you the good I have led you to expect by the statements above you can return what remains to me and cash the check.

When you write describe your condition so that I can give you the necessary advice.

Dr. John Warren Walker, 1 So. Hoyne Ave., Chicago, Ill.

$8.00 OUTFIT FREE

A Dunlap block, Derby or Fedora Hat	$2.50
A pair of stylish Lace Shoes, the new queen last	2.50
A Percale Shirt, detachable Collar and Cuffs	1.25
A neat Silk Four-in-hand Necktie or Bow	.50
A pair of fancy Web Elastic Suspenders	.50
A Japanese Silk Handkerchief	.50
A pair of fancy Lisle Thread Socks	.25
Thousands of American citizens pay Cash for this.	$8.00



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$35.00

This almost human piece of mechanism exceeds the capacity of the most skilled fingers

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RHEUMATISM

CURED THROUGH THE FEET

Poisons Drawn from the Blood through the Large Foot Pores by New Discovery. TRY IT FREE.

We want the names of 100,000 rheumatics. Write us today. We will send you by return mail a pair of the celebrated Magic Foot Drafts, the great new cure for Rheumatism, chronic or acute, Muscular, Sciatic, Lumbago, Gout, etc., no matter where located or how severe. We send them prepaid and you take them home and try them before you pay us one cent. Then, if you are fully satisfied with the benefit received, send us One Dollar. If not you pay nothing whatever. You can see that we couldn't afford to send out these Drafts on approval if they didn't cure, for no one pays until he is satisfied.

Cut showing network of veins in foot.

TRADE MARK

Magic Foot Drafts are worn inside the stocking without inconvenience and cure by drawing out and absorbing the uric acid from the blood, which is most easily reached through the large foot pores. The Drafts are curing hundreds of cases considered incurable. They are harmless—A safe, common-sense remedy. Costs nothing to try, and if cured, one dollar is little to pay. Booklet of remarkable testimonials free with the Drafts. Send no money—only your name. Write to-day to the Magic Foot Draft Company, 651 Oliver Building, Jackson, Mich.

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If It's Electric We Have It.——We Undersell All.

Battery Table Lamp	$ 3.00
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Telephone, complete, $2.50,	5.95
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Electric Door Bell Outfit,	1.00
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Complete Medical Battery,	5.00

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We are selling the BEST NEW CROP

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Oolong, Eng. Breakfast, Gunpowder, Souchong, Congou, Mixed, Japan, Young Hyson, Imperial, Ceylon.

Good Oolongs, Mixed and Eng. Breakfast, 25 & 30c a lb.

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ON a SAMPLE ORDER of $5.00 and upwards, of Teas, Coffees, Spices, Extracts and Baking Powder, we will allow you 20 per cent off and pay all express charges, so that you may thoroughly test the quality of the goods. This is a chance that is seldom offered; it gives all a chance to purchase our goods at less than cost.

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THE JAPANESE YEN.

When the public reads that 100,000,000 yen has provisionally been set apart by Japan for war purposes, it may perhaps put an exaggerated estimate on that amount. Although Japan has a gold standard, the yen is of silver currency, and fluctuates with the price of silver, so that at the moment 100,000,000 of them means scarcely more than $50,000,000. But even this is an immense amount in a country in which the wages of a skilful artisan are often not more than 3 yen a week. The Japanese currency system is decimal. Thus the yen, or dollar, is divided into 100 sen, or cents; the sen into 10 rin, the rin into 10 mo, the mo into 10 shu, and the shu, finally, into 10 kotsu. Government accounts do not take note of any value smaller than a rin, but estimates by private tradesmen often descend to mo and shu, which are incredibly minute fractions of a farthing. No coin exists, however, to represent these liliputian sums.

A FLAT WHEEL.

"That's a pretty noisy passenger you've got in there," remarked the man who was smoking on the front platform. "Is he crazy, or only drunk?" "Neither one," said the motorman. "He's just got a flat wheel in his head."

SUMMER THE BEST TIME FOR STUDY

People used to think that fall and winter was the only time to study and that there was little use in even thinking about such things at any other time. But experience has proven otherwise; not only that, but it has developed a most surprising and interesting fact. People who study in summer, as a rule, learn more than they would in winter.

The explanation of this is self-evident. It does require more will power to sit down and work out problems and commit to memory during a pleasant summer evening than if a blizzard were raging outside, but the very fact that some additional force is needed, seems to emphasize the effort. An engineer makes a run at high speed for a hill and goes over the top faster than otherwise; you break a bone and, ordinarily, nature will mend it stronger than before. So the person who has the bound-to-rise spirit in him determines to do some summer study and, in overcoming a natural inclination not to study, exerts so much will power that the result is a stronger concentration on the work than usual; and in the end the subject is more thoroughly comprehended. In evidence of this, statistics of the International Correspondence School (we quote from this school simply because it is the oldest and largest, and everywhere known to do good work) show most surprising and gratifying figures. While the number of students is far less during June, July and August, than at any other time of the year, the examination papers and positions afterward taken by their students show that it is the young men with the ginger to buckle down to study in the good old summer time, who are the boys that eventually get there and do things.

We are all working to accomplish certain ambitions; some one thing, some another; and in almost every instance the usual time in which these can be attained may be greatly shortened by striking ourselves, putting on steam and getting busy.

Young man, when the fall comes you will feel mightily pleased with the summer's work which has made you even fairly proficient in some branch of electricity, or any one of the several hundred courses now so successfully taught by mail; and you will take new courage for still greater progress from the increased pay which increased ability secures.